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British Standards Committee

THOSE who are familiar with the organization and excellent work of the American Society for Testing Materials will read with interest the article elsewhere in this issue on the plan, scope and accomplishments of the British Engineering Standards Committee, which does for the United Kingdom and the British Empire what our American Society for Testing Materials does for us. While it is gratifying to note the wide scope of the British organization, it is equally a cause of satisfaction to observe that our own society is still in the lead. Wherever a good direction is indicated in the British work, there too have we been working. It is interesting, in view of recent movements in this country, to know how keenly British engineers realize the relation which their work bears to the industrial progress of their country. Industry, fundamentally, is engineering and chemistry—the technical arts—and our British brethren are keeping this fact clearly in mind. Possibly this realization was not so clear-cut before the war as it is now. At any rate, the relation is now thoroughly understood.

Motor Trucks in Mexico

WHEN the punitive expedition under General Pershing was sent over the Mexican border last spring and the use of the Mexican railroad for United States' troops was denied, it became necessary to supply the entire force by means of motor transportation. The experience gained in the south foreshadows the passing of the army mule as the mainstay of military traffic. What motor trucks have done in Mexico was touched upon briefly by Captain Arthur P. S. Hyde, U. S. A., in a paper presented at the recent annual meeting of the Washington State Association of County Engineers in Tacoma. Until the War Department purchased hundreds of motor trucks for use in Texas and Mexico there was, Captain Hyde reports, considerable difference of opinion as to the relative value of mule-drawn wagons and motor-propelled trucks. The Mexican experience, however, has demonstrated conclusively the value of the motor truck for army service. Captain Hyde says: "It is unquestionably true that the motor truck as a means of military transportation has come to stay. While there will still be mule-drawn wagons accompanying troops and used for the distribution of supplies between various units, yet the connecting link between the army in campaign and the base of supplies at the rail-head will unquestionably be largely by motor trucks." He cites also an interesting experiment tried recently in the use of motor transportation for the handling of

troops. The Second Kansas Infantry on duty at Eagle Pass, Tex., was transported in one day by motor trucks to San Antonio, a distance of 150 miles. Had this regiment proceeded by marching, the distance could not have been covered in less than a week's time, and ten days would not have been unreasonable. The roads of Texas are not remarkable for their excellence either. This little sidelight on the Mexican campaign carries with it a lesson for contractors as well as for army men.

Belt Floats for Roads

SO thoroughly have methods of concrete road building been studied and standardized for several years past that there would appear to be no room for the development of new details. Nevertheless the use of an 8 or 10-in. belt, worked back and forth like a strike board, as described in the article on page 481, seems to be an innovation deserving of more than passing notice. After Mr. Bushnell's story was received the Engineering Record was informed that the same procedure had been used with success and profit in Wayne County, Michigan, and further that in California a thin, flexible redwood strip, $\frac{3}{8}$ in. thick, has been employed for the same purpose. In Michigan finishers are still required to handle the surface at the joints. On the Illinois road there are no joints, so that the method is all the more applicable. We are not informed as to the California work, but many miles have, in the past, been laid without joints. Anything that saves the contractor the grief of keeping high-grade finishers on the job will be appreciated.

Meddling by City Fathers

PHILADELPHIA last week was treated to the spectacle of a joint special committee of City Councils passing judgment upon a proposed ordinance regulating the sale of water by meters. John C. Trautwine, Jr., was present at the meeting and characterized its deliberations in these words: "A score or so of men sat for an afternoon darkening counsel by words without knowledge and hearing pleas from self-seeking manufacturers who are getting their water far cheaper than in most other cities, but who are nevertheless panic-stricken when the city proposes to add a fraction to what must be a very small proportion of their outlay." Speaking for the Engineers' Club of Philadelphia, Mr. Trautwine contended, in effect, that the working out of the details of a new water schedule was none of the City Councils' business. With this statement of the case the Engineering Record is in hearty accord. Philadelphia, as well as most other cities, has a

department of public works numbering in its personnel engineers of recognized ability. The formulation of a scale for water charges is a job for the department of public works and not City Councils. In fact, Mr. Trautwine contended that Councils, in considering the proposed water ordinance, were impertinently usurping powers placed elsewhere. In addressing the city fathers Mr. Trautwine did not mince words. "Whether or not your committee agrees with me that the charter does take these matters out of your hands, and does leave them in the hands of the department of public works, your committee must, I am sure, agree with me that it should do so. The salaries paid to your members by the city for their services are hardly sufficient to justify the city in expecting, at your hands, that expert knowledge which alone can entitle them to pass upon matters of this kind." It is high time that aldermen, councilmen and all the rest of the gentry whose names are bedecked with the prefix of "The Hon." should be prevented from dabbling in matters about which they know nothing.

Goethals and the Eight-Hour Law

RETURNING to the States last month, General Goethals told the newspaper men who inquired about his plans for the future that his mission here was "to look for a job." He was not long in finding one—and a pretty big one, too. His selection by President Wilson as a member of the commission to report upon the working of the newly enacted eight-hour-day railway legislation will insure a sound-minded, impartial judgment of the merits of the case. Whether or not the task is to General Goethals' liking it is impossible to say. "I am a soldier and can do nothing but obey the orders of my superior officer." This, the papers state, was the cryptic reply to questions regarding his opinion of the appointment. Nevertheless, it is well that a man of his caliber and training is on the commission. He enters upon his important duties not as a theorist but as an executive, who, at Panama, has had to deal with all phases of the labor problem at close range. Unlike some of our legislators at Washington, who, on all sorts of public questions, have exhibited a tendency to rush in where angels fear to tread, General Goethals is qualified to render an intelligent opinion. No man with his training could have any delusions as to what the "basic eight-hour day" really means. To engineers the appointment is particularly gratifying. Himself an engineer, the Panama Canal builder has demonstrated how problems of national importance may be efficiently handled by the right kind of technically trained man.

Paving Petitions—The Right Kind

UNDER the title, "Who Should Select the Pavements?" this journal on July 8 of this year scored the practice which allows citizens to determine what type of paving they shall have in front of their property. It condemned the practice, not only because property owners are not competent judges of types of pavements, but also because manufacturers and promoters of paving materials use the system for their own benefit, regardless of the suitability of their materials for the location in question. Engineers, generally, if they had their way, would put full control of this matter in the city's engineering department. There all the factors would be properly weighed. Political scheming and the influence, legitimate sometimes, illegitimate oftener, of the materials manufacturers prevent the general adoption of the plan. Some cities have already eliminated politics, and that means manufacturers' chicanery and promotion, from their pavement-extension work. One eastern city, which is under the commission form of government, has already adopted a rule that no petitions will be received or considered by the commission which name the type of pavement the citizens want. The petition may merely ask that a new pavement be laid. It is for the commission, advised by its engineering forces, the intelligent citizens of this community agree, to determine what pavement is best under the given conditions. This is a paving petition of the right kind. Its adoption deserves to become universal.

Water-Supply Prodigality

WHEN any town shows such an abnormally high water consumption as 665 gal. per capita daily it is clear that "something should be done." In the case of Tonawanda, N. Y., recently investigated by engineers of the National Board of Fire Underwriters, this "something" is nothing more than the well-known remedies of meters and tight pipe joints. The population of the town is only about 9000. In casting about for an explanation of the excessive amount of water used it would be natural to conclude that a very large commercial use of water is accountable, in part at least, for the high figure. This answer, however, is not satisfactory. It appears from the report of the fire underwriters that the excessively high per-capita rate is due largely to leakage, for during the night hours there is only a small decrease in pumpage as compared with day pumpage. The lack of action on the part of the city in reducing the enormous waste indicated by the high consumption has resulted in fire protection being seriously reduced, and will, according to the report, necessitate large expenditures that otherwise would be needless. In view of the fact that Tonawanda's water supply is not a gravity supply but is entirely delivered by pumping, it would appear, in the interest of economy, that a wholesale campaign of metering and leakage prevention should be undertaken at once. The present prodigality should not be tolerated.

Running History of an Engineering Design

RECENTLY a representative of this journal was shown a loose-leaf binder in which were kept records of the development of the design of an industrial plant—rough notes and sketches which recorded reasons for various decisions as to layout, details of construction, etc., and named the authority for each decision. Some structural engineers always take the time to keep such notes on each job. This is excellent practice, and to be heartily commended, even if not new. Memory is a treacherous resource when future difficulty or perhaps serious trouble arises. Wholly aside from the benefit of accuracy of record, it tends to insure that careful consideration of details which results in the best possible structure. The practice may be applied in every field of design and construction.

The notes have an additional valuable use—the preparation of reports and descriptive articles. The chief engineer of a large bridge company recently suggested that young engineers be urged by their superiors to write about their work, and even that some incentive be offered. He contended that it would not only develop facility in the use of technical English, but would give the young men an understanding of the broader aspects of their work and of its relation to other construction of a similar nature. Such an understanding should result in bringing new enthusiasm to tasks that threaten to become monotonous. As a basis for articles, a running history of the development of the design is invaluable.

It cannot be urged too strongly that every engineer keep such a record as outlined and use it as a basis for contributions to technical or society publications. Information on the reasons for the selection of types of structure, component parts and details leads, even though every problem is in a class by itself, to a more thorough understanding by designers of the principles upon which good design depends.

The day of individualism in the profession has long passed, and except within the limits of really new discoveries, no man should keep to himself improved methods or details. The profession as a whole can advance only as each member contributes to the fund of technical knowledge.

Straight Thinking on Reclamation Service Problems

WHEN the cost review boards were appointed by the U. S. Reclamation Service last year it was the opinion of this journal that the step was another move in the direction of repudiation, of a part at least, of the project costs. Certainly on the projects themselves this was the interpretation placed upon the creation of the boards.

The event fortunately has not realized the expectations. Engineers, of course, knew that with two such men as Brig.-Gen. William L. Marshall and Dr. Elwood Mead on the Central Board of Review the findings would be judicious. They have not been

mistaken. Instead of the huge cost reductions hoped for by the agitating elements in the West, rumor has it that the central board has recommended reductions of only about 10 per cent. Reductions have been recommended only where warranted. Each proposal of reduction has had to bear the searching inquiry of two very able engineers.

The Engineering Record has already commented upon one of the reports of the central board—that reviewing the Carlsbad project. Now there appears the report on the Shoshone project. While, fortunately, the board was not forced into the caustic comments which were demanded in reviewing the findings of the local board at Carlsbad, the Shoshone review contains an equal amount of common sense bearing on the proposal of cost reductions. For example, the report says:

"We do not agree that the just or effective method of extending aid [to settlers who have faced unsurmountable difficulties] is through reducing project costs. Such action would be a donation of public money to water users already enriched by the enterprise, not in need of aid, and not entitled to it. It would be the repudiation of an obligation to the government without any adequate justification."

And further we read: "A reduction in project cost is simply a donation. It does not give to those in need of assistance the amount required or in the form required."

We have no doubt that the publication of these reports in the *Reclamation Record*, a medium through which they will receive wide distribution in the arid sections, will do much to squelch the speculators and the agitators—and they are one and the same crowd—and bring home to all water users a keen sense of their legal and moral obligations to the government.

Snubbing the Other Eighty Per Cent

ASIDELIGHT on the recent struggle between the railroads and the brotherhoods, resulting in the so-called eight-hour law, is set forth in a report just issued by Robert T. Frazier, Jr., originator of the petition of "the other 80 per cent." Those who read in the Engineering Record of Aug. 12, page 189, of the movement started by Mr. Frazier may have wondered that so little was heard of it when the controversy reached the acute stage late in August. According to Mr. Frazier's report the signatures, 105,000 of them, were obtained and during the entire conference period Mr. Frazier and an associate were at Washington patiently seeking a hearing of a few minutes to present their petition. The President denied them the hearing. As he put it in a letter to Mr. Frazier, it was "really impossible for him to have personal interviews."

This journal does not know how clear Mr. Frazier and his associate had previously made it to the President's outer guard that they were there not as individuals but as representatives of a large group of men. The letter concerning "personal inter-

views," however, was in response to one from Mr. Frazier setting forth his errand clearly, so the President must have understood by that time. It is interesting, too, to note that the letters were dated Aug. 30 and 31, while the dates of the President's special message to Congress and the passage of the Adamson law were Aug. 29 and Sept. 1 respectively.

As the Engineering Record suggested when it announced the 80-per cent movement two months ago, it is unfortunate that it was not inaugurated a month earlier. A petition with 500,000 or 1,000,000 signatures could hardly have been so easily ignored, especially if it had obtained a goodly amount of newspaper publicity, as this one did not. The failure of the movement to help in the crisis just passed does not mean, however, that the efforts were wasted or that the issue is dead. In his letter of Aug. 30 to the President Mr. Frazier suggests that "the 80 per cent must of necessity organize and present their demands for recognition and protection." Whatever form this organization may take—and this journal hopes and assumes that it will never emulate the peremptory demands of unionism—it can confidently be predicted that the other 80 per cent will be heard from further, and that the snubbing they received at Washington will quicken their action.

A New Relation Between Engineers and Pure Scientists

LAST week we took occasion to call attention to the very rapid strides being made toward professional unity and toward the co-operation of engineers with other classes of citizens in public projects. Now comes the very important announcement, detailed in the news section of this issue, that the Engineering Foundation is lending its financial support to the work of the National Research Council, appointed, at the request of President Wilson, by the National Academy of Science. The step holds tremendous possibilities for the welfare of our country. It spells a new era in the relation of the pure and the applied scientists and shows that for the present at least the course of the Engineering Foundation has been determined.

The purpose of the National Research Council is to mobilize the scientific work of the entire nation for peace no less than for war. Its scope is necessarily wide. The questions needing answer are many. What are our research agencies? What are their characteristics, their excellences, their limitations? What changes are needed? What new agencies must be provided? What new relations must be established? What shall be the machinery for exchanging information? What are the problems that need solution? How much has already been done? What gaps must be filled by new research? What agency is best fitted to carry on the work? What groups of pure or applied scientists can co-operate in and further the investigation? These are some of the problems that offer themselves to the council. That they must be answered if our nation is to be truly efficient, only those

fully realize whose connection with research work has disclosed duplication, inefficiency and lack of data on essential phases of important problems.

That the body is qualified to handle big problems its personnel clearly shows. Not only are the members leaders in their specialties, but most of them represent powerful bodies of engineers and pure scientists. From every organization which can contribute to the success of this mobilization of the scientific brains of the country co-operation has been assured. The National Academy of Science, the American Medical Society, the American Association for the Advancement of Science, all the great chemical bodies, all the leading national engineering societies, and the industries which have led in research are represented by members or officers. At the same time these men represent particular specialties and will bring to the work of the council the varied experience which will guarantee for every problem the broad consideration necessary in order that its full bearings on the military and the industrial future of our countries may clearly be seen.

The significance of the council's foundation from a national point of view can hardly be overestimated. We have been a prodigal nation. We have wasted our natural resources. In the rush for profits we have skimmed the cream and thrown away millions in waste. Our standard of efficiency was set at an immediate gain, without regard for the future and for the scientific efficiency of the performance. And yet, as a nation, we prospered. We were living in a garden, or, as a German student of American conditions has expressed it, in a gold mine. The country was rich and was developing rapidly. The market was large. Initiative was the chief asset needed for success. Now the conditions are different. Our own market has, relatively, narrowed, for there is more competition, and that competition has forced economies and waste utilization never dreamed of twenty-five years ago. With narrowing home markets comes the temptation—in fact the need, if we are to have a stabilized industry—of getting foreign markets. There we have encountered a German competition—a competition based on scientific analysis of products, and even of foreign finance and selling methods. Engineering and scientific research have thus been forced upon us. But as yet we are working, in large part at least, as individuals or as groups. How much duplication there is, how large the gaps in our scientific researches, whether military or industrial, what opportunities for co-operation are lost, no one can know. Now we propose to find out—to mobilize our research activities, to bring individuals and groups into contact with others who are working on the same or allied problems, to the end that when figured on a national basis our efficiency rating will be high, our military resources and industrial organism second to none.

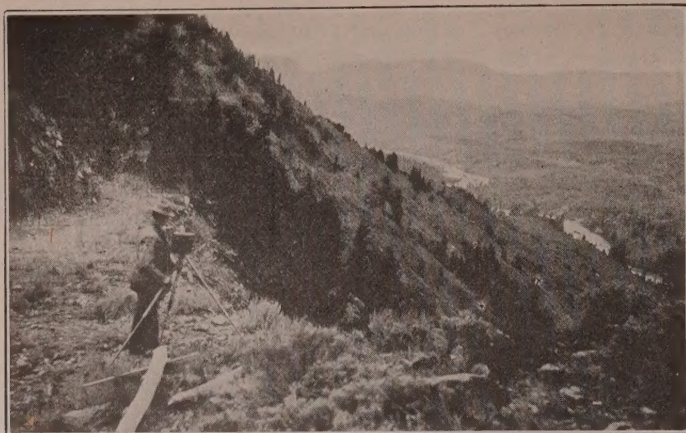
But these remarks refer to the origin and scope of the council itself. What of the co-operation which it establishes between the engineer on the one hand and

the pure scientist on the other? Between the pursuits themselves—pure science and engineering—the relation is necessarily close. In fact, it is hard to tell where the one ends and the other begins. The one term, "scientific research," properly covers investigations whether along engineering lines or those of pure science. The scientists form the advanced guard of the industrial army. They do the pioneering work. They extend the bounds of human knowledge and leave to the engineers who follow the development, along practical lines, of the principles they discover.

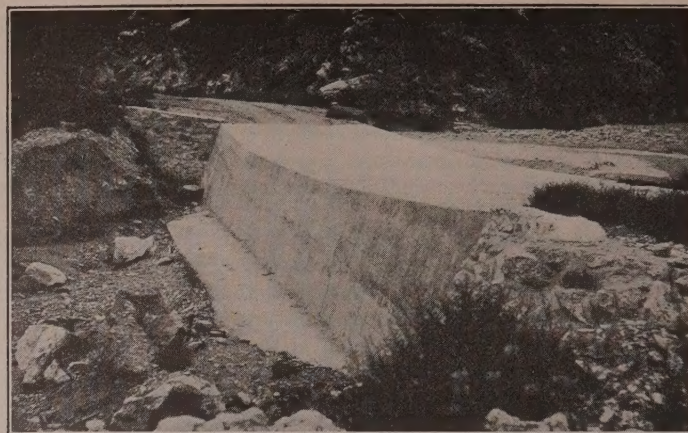
As far as the intrinsic relationship between pure science and engineering is concerned, there is no need that a new bond be formed. The pursuits themselves are closely drawn together—not always so, however, the men themselves. The relationship established between the engineers and the pure scientists through the co-operation of the National Academy of Science and the Engineering Foundation will be as it was, "the outward sign of an inward grace," that will be to every engineer and to every scientist a keener appreciation of the closeness of the relations of their occupations. New vistas will thus be opened before each class of workers. The engineer will be the more ready to turn to his strictly scientific brethren for assistance; the scientist more eager even than now to direct his resources along lines that are most likely to turn over to the applied scientists material which will aid them in solving their practical problems.

Finally, the action of the Engineering Foundation in offering its financial support and the services of a secretary to the National Research Council indicates that the foundation has determined upon at least one of its lines of activity. It has been importuned to support particular researches of many different kinds. Many of the suggestions were admirable, but each looked to the solution of only one small problem that confronts the scientific and the engineering world. Rather than spend its substance on the solution of these individual problems, no matter how praiseworthy such activity might be, the foundation has chosen to promote research broadly.

In reaching this decision the Engineering Record believes that the Engineering Foundation has acted wisely. We can conceive of no better direction for its activities than the raising of the efficiency of all the scientific research of the country. If the National Research Council realizes the high hopes which we entertain for it, that end will be brought about. Fortunately, men of affairs, who have brought large enterprises to a successful conclusion, as well as those distinguished in scientific research, are interesting themselves in the work. Their participation is a guarantee that the council will accomplish what it is setting out to do. The very best wishes of the scientists and engineers of the entire country go with them in their endeavors and will undoubtedly be backed by all of the co-operation which the council will ask from them as individuals and through their societies.



SCENIC BEAUTY OF GORE CAÑON ROAD OFFSETS NARROWNESS



FORD FOR DRY ARROYOS CARRIES DÉBRIS OVER ITS TOP

Disintegrated Gravel, 1000-Mile Tour Shows, Is Best Natural Highway Material in Colorado

Large Mileage, Using Metal at Roadside, Is Like Boulevard—Most Important Elements in Maintenance Are Adequate Drainage and Sloping of Surface Downward Toward Uphill Side

By W. W. DE BERARD

Western Editor, Engineering Record

COLORADO has 6000 miles of state roads, and a trip over 1000 miles of them, mostly in the mountains, was made recently by the state highway engineer, J. E. Maloney, T. J. Patterson of the Hardesty Manufacturing Company, and the writer. With few exceptions no detailed studies were made, as the general impression on the ultimate user and conditions at points where this season's work has been prosecuted were desired. Furthermore, the trip was made in a week, involving night driving when visual inspection was limited. The itinerary covered the Rainbow Route, west of Colorado Springs, to Grand Junction, a side trip to Pagosa Springs from Saguache and a return by

the Midland Trail up the Grand River and over Berthoud Pass.

The enormous mileage of roads in boulevard condition made from material found at the roadside was the most noticeable feature of the trip. Drainage and the sloping of the road toward the bank on side-hill work easily outweigh all other mountain-road precautions. Two or three experiences on a slippery side-hill road with 1000 ft. of sheer cañon wall below leave no doubt in the mind of the automobile driver as to the proper abode for the road builder who overlooks these vital points.

We started from Denver—and by the way, Denver has many miles of disintegrated-granite-and-slag-paved residential

streets which continual watering and an occasional reshaping keep in excellent condition, although why oiling has not been resorted to in this dry climate where water is so expensive and evaporates so quickly is a pertinent question. Oil-company experts tried it once and made a mess of it, they tell you, so no one else has had the temerity to experiment again.

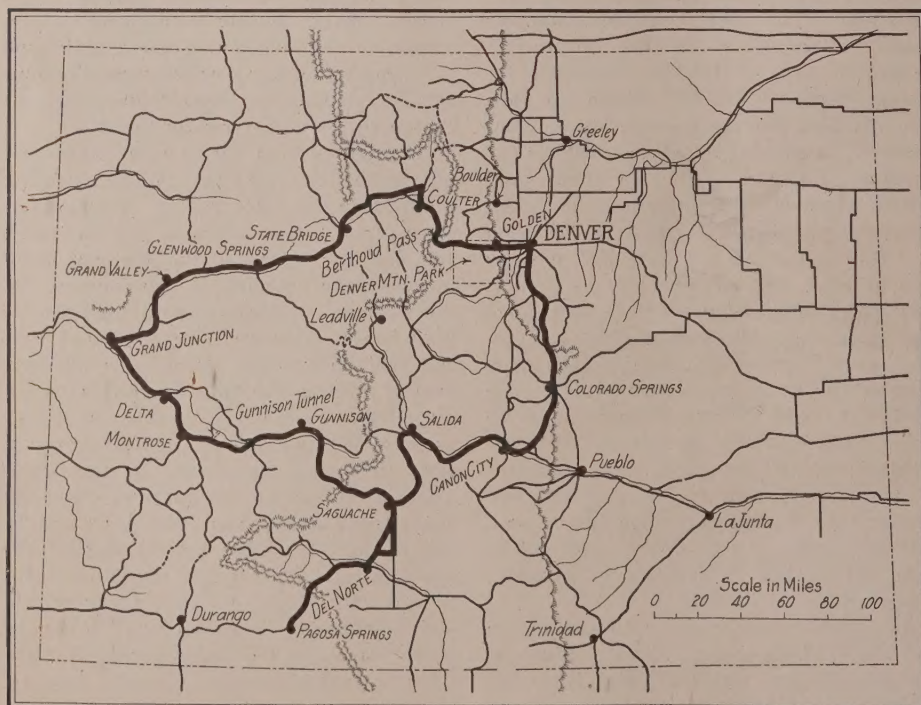
CLAY-GRAVEL ROADS

The itinerary carried us first to Colorado Springs over 75 miles of clay-gravel roads in almost perfect condition. In spots this road had recently been scarified, reshaped and redressed with 2 in. of pea gravel, a procedure costing approximately \$800 per mile for an 18-ft. roadway. Over clay it is the practice to place 4 in. of gravel the first year, let the traffic work it in and then apply 2 in. the second year. By the third year the road is likely to require scarifying, reshaping and the addition of 2 in. of gravel. This road, which is part of the Great North and South Highway paralleling the eastern foothills through the state, is so much traveled (we encountered more than 110 machines in the 2¼ hours of running) that all three counties—Arapahoe, Douglas and El Paso—are making a special effort to keep it in shape. Two years ago most of it was reggraded, and it is now dragged after every rain. Maintenance costs about \$50 per mile per year.

Colorado Springs is entered over a stretch of Tarvia-covered, disintegrated granite in fair condition. One gallon was applied three years ago, ½ gal. last year and something will have to be done this season, for the pavement shows the patchy appearance seen in Denver, but it certainly is not impossible to repair.

CONCRETE FORDS

Ten miles from the Springs on the way to Cañon City the road starts up the mesa on 6-per cent ruling grades and minimum 30 ft.-radius curves. Twenty-eight miles of relocated road was built by convict labor



PRINCIPAL ROADS IN COLORADO—ROUTE COVERED IN TOUR SHOWN HEAVY

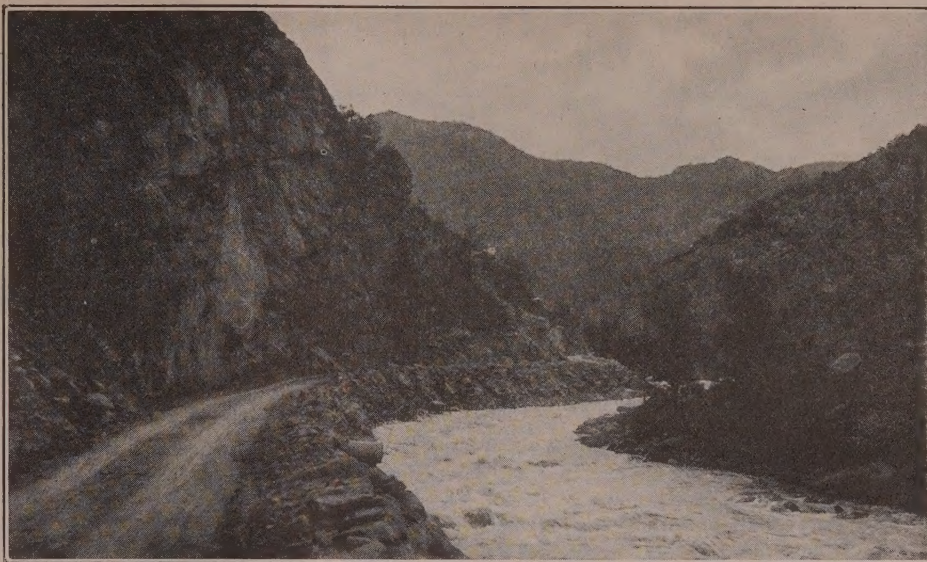
and opened in 1912, since which time much of the clay has been graveled. Constant maintenance has given it a smooth, compact surface, wet or dry. The natural material on the ascent is red disintegrated granite, which packs quickly under traffic, and requires dragging only to keep it in excellent condition. The road is 16 ft. wide and has inside longitudinal drainage on sidehills to culverts under the roadway.

Another 10 miles on the way to Cañon City we came to a concrete ford to carry water from a dry run over the roadway. This ford, like the one at the end of the convict work above Cañon City, shown in the photograph, has a small opening to pass the ordinary storm flow. Heavy downpours bring much debris, and in the higher altitudes winter snowslides are so destructive of bridges that the ford is the only feasible solution for a permanent structure. The precaution of ample protection from undercutting for the downstream side is usually attained by placing large rocks for the water to fall on.

Over the first auxiliary range the fertile irrigated Arkansas River valley spreads out in panorama. Very soon the difference in natural road materials is evident. The limestone-shale and marl whites appear. The stacks of the cement plant at Florence later on assure one of the nature of the material. The road is dusty. Maintenance by dragging helps materially in dry weather, but high crowning for quick drainage is the bane of the motorist's life in wet weather. Visions of Iowa and Illinois return. An average of \$2,500 per mile has been spent on grading a 16-ft. road on the west side of the pass, and there are few heavy cuts. About \$600 per mile is now being spent to haul and spread a 2-in. gravel layer. Travel will compact it.

CONVICTS DO HEAVY WORK

Heavy rock work has been done by convicts on 10 miles of the road along the Arkansas River toward Salida. It starts 12 miles out of Cañon City after descending a steep, narrow, winding natural road over a hill around the famous Royal Gorge. The beginning and end of the convict road is marked, and a monumental slab to the prisoners has been erected on one side of a rock cut. The two years' task was completed in 1915. This work was paid for by



THE ARKANSAS RIVER ROAD IS BUILT PARTLY IN THE BED OF THE RIVER

Convicts completed this highway in 1915. The slope to the longitudinal drainage ditch is flat and traffic has begun to depress surface at wheel tracks, showing need of maintenance.

Tremont County and the State Highway Commission, but no accurate cost data are available.

The rock drilling was done mostly by hand, although two Sullivan air drills were used in the heaviest sections. The method in sheer walls over the Arkansas River where the height is not more than 40 to 50 ft. was as follows: Holes were put down along the line of the finished back wall 8 to 12 ft. in depth and the material dropped into the river bed. The grade at these points was chosen so that the blasted material was used partly for roadbed. This, of course, is not feasible where the road is any distance above the water level.

This road affords an excellent example of the necessity for continual maintenance and of keeping the tailings out of the longitudinal drainage ditch on the bank. When this road was completed these two most important essentials to mountain road construction were amply provided for. The ditches lead to corrugated Armco pipes, which are laid at least 12 in. under the roadway and deliver the water well beyond the outer bank. Although it is practically all made of crushed hard granite, the sur-

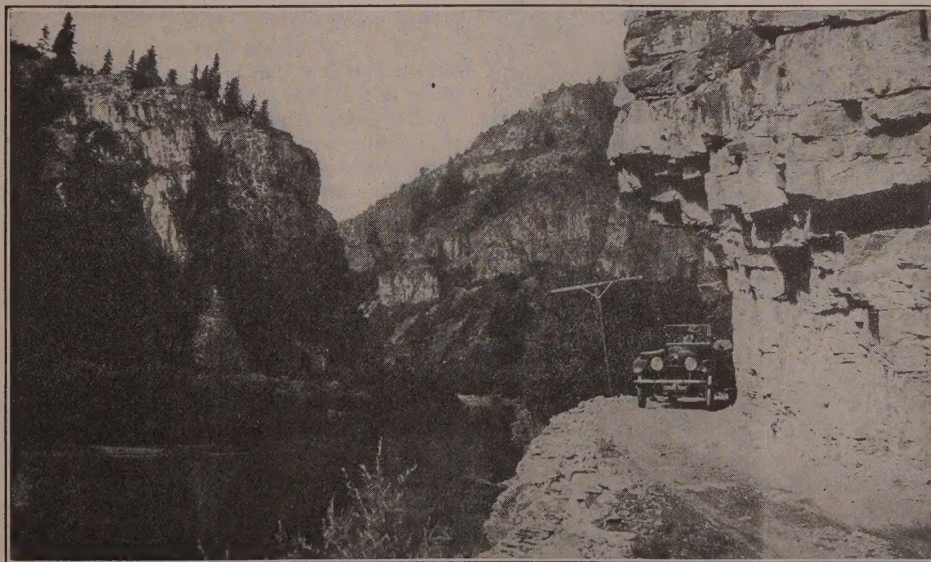
face shows the need of a road grader to fill in the depressions and longitudinal ruts which are beginning to form. The straight-line slope toward the bank now has two sags at the wheel tracks, illustrating the reason for advocating a parabolic crown with the outside edge highest. Attainment of this refinement in Colorado is not likely until maintenance is in the hands of engineers instead of the 200 road overseers appointed by the county commissioners. To secure a sloped straight line from outside to inside with the tailings well removed from the inside longitudinal drainage ditch will have to be the ideal for many years to come.

Last winter a professor at the University of Illinois read a paper at a road conference complaining about the attention and publicity roads were getting to the exclusion of the small-town streets. Most of the small towns on this trip bore out the contention as to the fact that town streets are poor in comparison with the country roads.

Local apathy toward dragging or light grading coupled with the denser traffic accounts for the condition.

THE SMOOTHEST ROAD

Probably the smoothest road encountered was a 7-mile stretch of natural material, gravel and clay recently regraded south of Villa Grove at the head of the San Louis valley. As it was late at night, details of side drainage and culverts could not be observed. The heavy wide-blade grader outfit moving to a new scene of activity was encountered in the town. It consisted of an extra-wide-tired gasoline tractor, a wagon loaded with gasoline barrels, the grader and a portable bunk or cook house. When it was built any attainable speed was practical on this road, straight as an arrow, level as a floor. The upper end, where there is gravel, is still good, but constant dragging is essential. The light loam farther down the valley, so desirable from the irrigated farm standpoint, is not good road material by itself. In dry weather it powders to dust; in wet weather it is greasy. A strenuous effort is made to keep it in shape by dragging, but despite this, travel to Del Norte takes the natural winding two-track desert road to the west close enough to the foothills to have incor-



CONVICTS WIDEN NARROW GRAND RIVER ROAD NEAR SHOSHONE POWER PLANT

Where rock is sheer for hundreds of feet construction is heavy and chances must be taken with overhang



SOILS OF IRRIGATED COUNTRY NEED CONSTANT SPRINKLING



THE GRADER IS THE PRINCIPAL ROAD TOOL IN COLORADO

porated in the soil plenty of disintegrated granite. For miles this follows the main ditch of the Farmers' Union, but never does the desert road lie in tangents. Withal, it is easier and more pleasant to drive over than the straight road.

FOREST-SERVICE ROAD

The Forest Service allots a portion of its funds for foraging and other privileges to build roads into and through the forest reserves. The service co-operates with the state and county officials and is allotting these funds to assist in bridging the gaps over many of the mountain passes. Such an arrangement is under consideration for about 24 miles of the road over Engineer Mountain and Molas Lake Pass, south of Silverton, on the road to Durango. At present tourists ship their cars by rail between the two points. Our trip back took us over the recently completed Wolf Creek Pass to Pagosa Springs (see the Engineering Record of Sept. 23, page 378), then back to Saguache and over Cochetopa Pass, in which an excellent example of Forest Service road, 16 miles long, was observed. This 14-ft. road was completed in 1915 and has been well maintained by dragging. It is built according to the specifications of the State Highway Commission with 6-per cent ruling grades, proper slopes and well-defined longitudinal ditches on sidehill work leading to corrugated-iron culverts. The ditches are kept commendably clean of tailings. The surface, which for much of the mileage is volcanic rock or disintegrated granite, is easy to maintain. There are no heavy cuts, and the principal features are two switchbacks with turns of 30-ft. radius on the west side to gain elevation from the valley mesa. On this side, by the way, limestone and surfacing material are not so easily obtained.

The real criticism of this route, as of so many others, is the abominable road beyond its western end on the way to Gunnison. Two wheel tracks, with the soil washed off the sharp rocks below, describe it. A few hundred dollars would make the worst places passable. As the county and the state both paid a large share of the cost of the government road the officials of the county, who control the expenditure of moneys furnished by the state, might well have devoted a little to making the Forest Service boulevard more available. Again the iniquitous principle of county control of through roads is indicted.

CULVERTS NEED COVER

West of Gunnison my notes are full of complaints against sidehill road not being drained toward the bank. Then near Cimarron there is a dash, for only the quick

wit of the driver saved us when he speeded up his cautious forward movement so that it exceeded the faster side slip toward a "yawning chasm."

Exposed culverts a-plenty were observed in this section as in many other places. To get effective service from these culverts they must be buried below any possible chance of wheel wear and deformation from the weight of traffic.

Leaving Sapinero, and before the ascent out of the famous Black Cañon of the Gunnison, the road is cut from solid rock, dumped into the river, as was the convicts' road near Salida. Up and up on 7-per cent grade the Blue Mesa road winds in and out of the rolling mesa hills for several thousand feet in elevation, while all the time the ribbon of the steeper Black Mesa road on the north side of the great slot is in view. The road is well graded and dragged with no unusual features except the magnificent scenery.

INTO IRRIGATED COUNTRY

Over the Cerro Pass into the Uncompagre valley the road has been graded and is dragged regularly. Dropping by a gradual slope into the valley, the winding mountain road soon gives way to the tangents of the

fertile irrigated areas. The change comes opposite the abandoned black shacks of the Reclamation Service force which built the Gunnison Tunnel—and some considerate engineer has erected a tablet telling just how many hundred feet below the road the tunnel is.

The roads in the irrigated districts are well maintained, for intensive farming means heavy trucking. Dragging follows every rain and sprinkling.

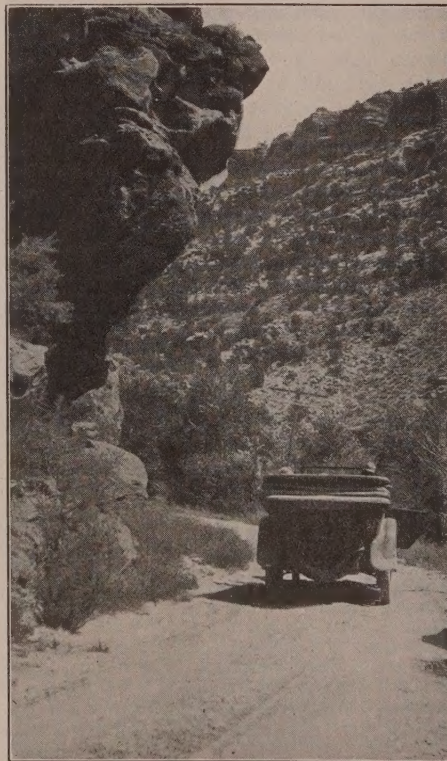
In Montrose, Delta and Grand Junction the sprinkling wagon is constantly in evidence. Out of Grand Junction the road is sprinkled all the way to Palisades, 14 miles. A man and team with a sprinkling tank (and a gasoline engine to pump water from a wayside irrigating ditch) are employed at \$100 per month to sprinkle and drag a district of approximately 4 miles. By this means the light loam soils are made to bear up the heavy fruit-wagon traffic. Little dust was in evidence and the roads were hard and smooth. Probably they are heavy during the wetter season.

MATERIALS VARY WIDELY

A reddish sandstone encountered west of Glenwood Springs and east of New Castle makes excellent road material, while a few miles back at Silt the soil was true to name. Dry and dragged it was like the Grand Junction loam roads. Through the red rock some heavy cuts have been made along the Grand River, giving an excellent scenic road. The materials vary rapidly, for the strata are on end. Just before entering Glenwood Springs even gravel hills are encountered, giving plenty of available surfacing material.

East of Glenwood Springs convicts are building a new road along the river to replace the old stage road. New alignment to give 6-per cent ruling grades and a 16-ft. roadway will necessitate carving a road from solid rock for at least 15 miles. Only thirty-five men were in the camp, many of the "honor" men being used on the state farm. The supply of convicts has diminished by about twenty per month since Colorado went dry. The population of the penitentiary has decreased by 111 since Jan. 1, no mean factor that must be considered in future convict road work of the state.

A Marion 1-yd. steam shovel, manned by convicts, except for one paid operator, is used for earth and loose rock excavation. Steam drills manned entirely by convicts are used on the rock work. This road is closed to travel during working hours because of the danger when setting off blasts. The work will progress all winter, the men being housed in a very substantial, electric-lighted camp. Shoshone power house is just above camp, and the question arises as to



OVERHANGS IN THE SANDSTONE ARE NOT CONSIDERED DANGEROUS

why electric tools are not utilized to a greater extent.

Out of Wolcott until the Gore Cañon is reached, the country is uninteresting. There is much clay and alkali road, greasy and treacherous when wet, but fairly well maintained as a whole, and therefore not so bad when dry. Only it never is all dry at once.

On the road was encountered what a road engineer of Wisconsin calls cubical clay—one that is friable and breaks up into cubes when only slightly moist. It makes a most excellent binder for a gravel road.

Scenery is worth noting along the Gore Cañon. The Moffat road is at the water's edge; the highway is up thousands of feet upon the side of the mountain. The road is extremely narrow and the turns sharp. Not much has been done to it since its construction by the Moffat railroad engineers, beyond keeping its natural surface in shape.

IN BERTHOUD PASS

From Kremmling to the foot of Berthoud Pass the road follows the Grand River in general. However, it leaves the river from Parshall to Hot Sulphur Springs to avoid a closed cañon, necessitating a considerable rise over a minor pass. It was realigned and well graded two years ago and has been well maintained since. From Hot Sulphur Springs to the foot of the pass much of the road, newly constructed since the Moffat road was built, is through disintegrated granite country. Of all the road materials encountered disintegrated granite gives the best service with the least attention.

Both sides of the pass are being improved at present. The north side has been pretty well completed as to new alignment, grading and draining, although a few stretches of corduroy badly in need of repair reminded the writer vividly of the same spongy spots when ridden over with a bicycle 20 years ago. In heavy work of grading the realignment is still under way. The old road is being widened to 16 ft., exclusive of the drainage; the old grades are being reduced from 10 and 15 per cent to 6 and the curves to a minimum of 30-ft. radius. Snow is almost at one's hand nearly the whole year; in consequence moisture is the road's worst enemy. The pass was reached at 7 p. m., so that no photographs of the work, with the magnificent scenery as a background, were possible.

THIRTY-MILE SCENIC HIGHWAY

To Denver now seems but a few miles, but pause must be made to observe the wonderful 30-mile stretch of mountain-park scenic highway built west of Golden through the co-operation of the State Highway Commission, Jefferson County and the Mountain Park Commission of the City of Denver. It is 20 ft. wide, sloped properly to the hillside, surfaced with the natural disintegrated granite and maintained constantly with graders and drags. Rollers are not used; in fact, not a roller or evidence of one was seen on the trip. To allay the fears of the timid tourist a substantial guard fence of discarded $\frac{3}{4}$ -in. wire cables and 8-ft. sandstone posts, buried 4 ft., lines the road wherever there is the least suspicion that a car might go over the bank. It has saved two unmanageable machines so far. And the fine thing about this road is that the way to it, from Denver to Golden, over the worst gumbo in the state, has now been graveled and a start made to build a concrete road between the two cities.

Some Settlers, Not All, Need Help on Shoshone Project

Indebtedness Varies—Strongly Oppose Reduction of Project Costs—Government Loans and Bureau to Assist Beginners Suggested

THAT all settlers on the Shoshone project in Wyoming are suffering from meager returns, lack of capital with which to improve their farms, and from inability to borrow money is not a fair presentation of conditions. As outlined in the report of the Central Board of Review, of which Elwood Mead is chairman, to Franklin K. Lane, Secretary of the Interior, the sorry plight of the settlers described in the report of the Local Board of Review conveys the impression that all of them are far from comfortable. The report of the central board scores the suggestion that the project costs should be reduced. "Such reduction," the report says, "is simply a donation. It does not give to those in need of assistance the amount required, or in the form required.

FEW LOSSES TO SOME WATER USERS

"Some of the water users have not been subjected to any of these discomforts, anxieties, or losses. Some had ample capital, and have comfortable homes, and they have found on this project a far better opportunity than could have been obtained in irrigation development under private enterprise. But there are settlers who have had to suffer losses, and whose condition is now critical. We believe that it is a mistake to permit settlers to enter on lands and projects of this kind who have not capital enough to give them a reasonable chance of success, and we also believe that there should be an organization to direct the work of beginners and save them the waste and loss due to inexperience.

"Such settlers have the sympathetic consideration of all members of this board, and we believe that they are entitled to such assistance from the government as will enable every man of industry and thrift to keep his home and complete his payments for land and water. We do not, however, agree that the just or effective method of extending aid is through reducing project costs. Such action would be a donation of public money to water users already enriched by the enterprise, not in need of aid, and not entitled to it.

INITIAL DIFFICULTIES ONLY TEMPORARY

"All the members of the local board concede that present financial embarrassments are temporary, and that so far as agriculture is concerned much better results may be anticipated in the future. The agricultural records of the Garland division support this. The average acreage return for 1915 was \$16.51, an increase of \$1.50 an acre over the previous year, and an increase of \$5.55 an acre over the average of the first seven years quoted in the supplemental statements. It was the testimony of all the settlers talked to during the recent visit to the district by the members of the central board that the color of the soil is changing, showing that its humus content is increasing, and there is a distinct gain in production.

"Market facilities have been greatly improved by the recent completion of a railroad south to Denver; a sugar beet factory at Billings and another factory to be constructed still nearer the district are destined

to furnish a market for one of the most valuable crops grown in this section, and one which fits in well with stock raising, for which the district is eminently suited. One reason why the acreage return of these settlers has been low is that they lack capital to buy live stock. Once that difficulty is overcome, agriculture will be much more profitable. In our inspection of the district the impression created was that it has passed through its most trying period. It has a gratifying aspect of solid prosperity with every condition favoring increased acreage returns and better social conditions.

INDEBTEDNESS OF SETTLERS

"There is another aspect of the financial situation of settlers that must not be disregarded. While the reports speak of the average indebtedness of settlers as being \$1,000, this is not the actual situation. The indebtedness of settlers varies greatly. Some do not owe anything; some owe \$4,000 and possibly more. Some are so prosperous that a donation of any part of the actual cost would be an act of mischievous and unwarranted favoritism.

"Three members of the water users' association board of directors are bankers. Two are bank presidents. These men are not developing farms to secure a home. The land is cultivated by tenants. Further, on this new project of 500 farms under cultivation, 107 are cultivated by tenants. A considerable portion of this area has apparently been filed upon by speculators. The stocks of the local banks sell above par, and as most of their money is loaned to settlers on the project it shows that local bankers have confidence in these settlers' solvency and in their ultimate success.

"It has to be borne in mind that this government project is only a small part of the irrigated area of Wyoming; that the greater part of the acreage has been reclaimed by settlers who had to finance their own enterprises, and where money was borrowed had to pay high interest rates for the money spent on construction.

OFFSETS TO HAZARDS AND EXPENSES

"As against the hazard and expense they would have had to incur, the settlers on these projects have had the advantage of low railway freights on material and the best of engineering advice; no interest has been charged on the money invested by the government during the period of construction, and none will be charged during the remainder of the payment period. These things of themselves place the settlers on this project at a great advantage compared to settlers on lands developed by private enterprise, and to add to this a donation of part of the cost is only justified on the assumption that the building of this work was an engineering blunder, or that the people living under it are not held to the same obligations to the government that exist in ordinary commercial undertakings. There is nothing here to indicate that this was an engineering blunder. On the contrary, everything indicates that the benefits of irrigation on this area are ultimately to be far more than the cost, and, taking the project as a whole, are already far more than the cost. The rise in land values alone supports this fact.

"These lands were given to settlers on only the payment of a small filing fee. While the average expenditure for improvements has not exceeded \$50 an acre, some of the land in the vicinity of Powell sells for \$100

to \$150 an acre. The unearned increment of itself equals the project cost, and there is no warrant for eliminating any of these costs where the settler is out of debt, is prospering, and has already been greatly benefited by the privilege of securing public land.

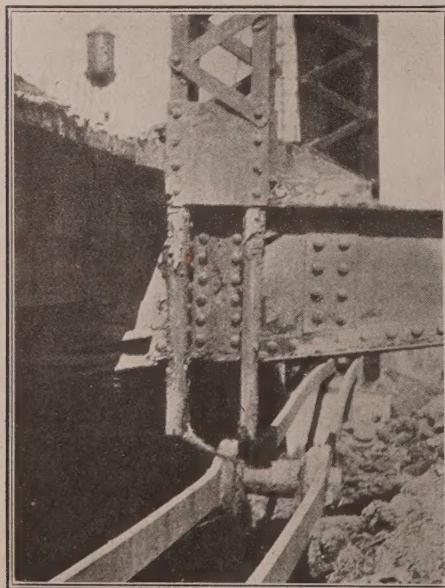
"Not all of the settlers have been thus benefited. Some of the land is not worth the sums spent on its improvement. There has been no enhancement in values beyond that created by the expenditure of money and labor. The credit of settlers who secured land of this character and their ability to borrow money are therefore restricted as compared to their more fortunate neighbors. While, therefore, some settlers are prospering and do not require assistance, there are a considerable number whose position is precarious and who are, in our opinion, entitled to adequate effective assistance from the government.

REDUCTION IN PROJECT COSTS IS DONATION

"The objection to a uniform reduction in project costs is that it makes no distinction between those who need assistance and those who are able to pay their way. A reduction in project costs is simply a donation. It does not give to those in need of assistance the amount required or in the form required. Nowhere is that more clearly illustrated than on this project. Those in need of assistance are chiefly settlers who began this development with inadequate capital; and their future is not menaced by the payment of project costs, but by the high interest rates they are charged for money, or the inability to obtain money for improvements.

"If these settlers are to be effectively aided, this country must follow the example of other countries which have a successful land settlement policy and provide money for improvements on a system of long-time loans with amortized payments of principal. This should be supplemented by an organization to direct the preparatory work in making raw land ready for cultivation."

The foregoing report is signed by Elwood Mead, professor of rural institutions, University of California, and by Brig.-Gen. W. L. Marshall, former chief of engineers, U. S. A., now consulting engineer to the Department of the Interior, and I. D. O'Donnell, supervisor of irrigation, U. S. Reclamation Service.



HANGER CONNECTION TO EYEBARS EATEN THROUGH BY RUST

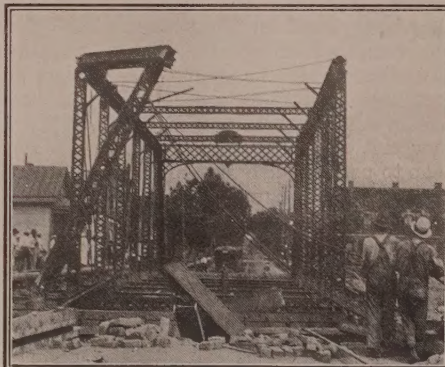
Corroded Metal Found in Old Truss Bridge

Iron Highway Truss Span in Memphis, Tenn., Replaced by Concrete Culvert for Full-Width Street

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

INACCESSIBLE parts of the last important iron highway bridge in the city of Memphis, Tenn., torn down in August last and replaced by a concrete culvert to carry a full-width street over Bayou Gayoso at Mill Avenue, showed considerable corrosion. The removal was accomplished by blocking up on a new fill over the culvert and cutting through the top chords and verticals with oxyacetylene burners.

The bridge was a nine-panel Pratt truss of 145-ft. span, 25 ft. 6 in. center to center of trusses, built in 1892 by the Penn Bridge Company. Bayou Gayoso is normally a dry creek flowing through the city, and originally drained 5000 acres of built-up city area. However, since the construction of two intercepting tunnels as a part of the North Memphis flood-protection work, described in the Engineering Record of June 10, 1916, page 775, this area has been reduced to 2000 acres, and a 15 x 24-ft. semi-

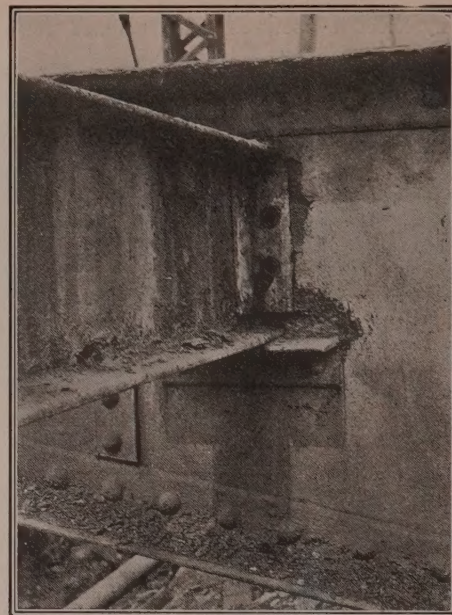


PULLING SECTION OF TOP CHORD AFTER CUTTING WITH TORCH

circular arch culvert has been built to replace the old iron bridge. The bridge carried, in addition to ordinary street traffic, a double-track street railway, and had been subjected to many vicissitudes. In 1905 a street-car derailment seriously damaged one of the intermediate posts near the center of the bridge and both diagonals, which were successfully repaired in place. It was subjected to overflow in the high water of 1907 and was then raised 5 ft.; but in spite of this it was again overflowed in 1912 and 1913.

The inaccessible portions of the bridge, as a result of failure properly to clean and paint them, and augmented by the floods mentioned, had become badly corroded. Some of the affected members—a hanger entirely eaten through above the lower-chord bars, a main floorbeam almost eaten through at the center post on the same side, and holes through one of the main floorbeams at the connection to one of the stringers carrying the street-railway track—are shown in the photographs.

The concrete arch to replace the structure was begun during 1915, but owing to continuous high-water conditions it was impossible to finish it until Aug. 15 of this year. As soon as possible after completion of the north end of the arch a fill was placed over it to carry foot passengers and to provide a working space under the old bridge,

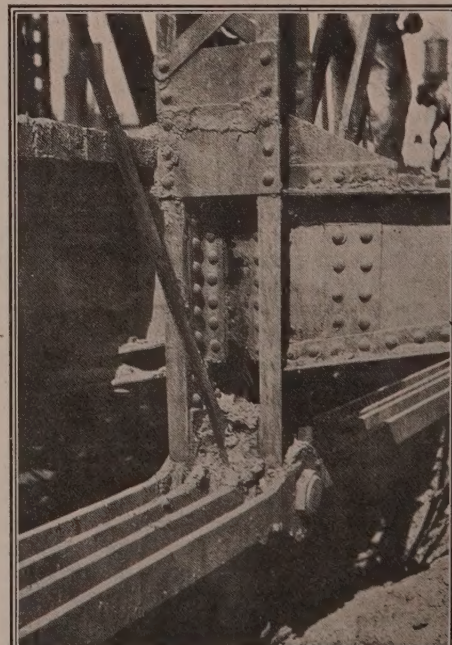


CORROSION AT STRINGER CONNECTION

the destruction of which was then begun.

By blocking up all of the cross-girders on the fill beneath the structure and then cutting through the top chords, and also the posts near the top of the cross-girders, with oxyacetylene burners, the post and attached section of top chord could be pulled inward, as shown in one of the illustrations. A street-railway wrecker then pulled the posts away. After the posts and top chords had been removed, the bottom pins were knocked out where not too tightly rusted, or the tension bars were cut off, the stringer rivets were cut, and the cross-girders and other materials dragged out by the same wrecker. The street-railway tracks were removed on July 26, the last top chord dropped on Aug. 5 and the entire structure taken down by Aug. 12.

When the fill is completed over the arch the street will have its full width of 66 ft., with 40-ft. roadway, instead of the limited width over the old bridge, and the grade of the east approach will be reduced from about 6 per cent to less than 2 per cent.



DIAPHRAGM AT FLOORBEAM CONNECTION ENTIRELY GONE

Should Wider Joints Be Provided in Concrete Roads Laid Late in the Season?

Heaving of Slabs on Canadian Highway Project Causes Noticeable Jar to Traffic on 6 Per Cent of 2071 Joints in Last Year's Work

By H. S. VAN SCOYOC

Chief Engineer, Toronto and Hamilton Highway Commission

DURING 1915 the Toronto and Hamilton Highway Commission laid 162,841 sq. yd. of concrete paving on the highway that will connect the cities of Toronto and Hamilton. On account of an exceedingly wet summer which delayed the work the mixing continued until late in November. An unusually mild fall allowed this to be done without any noticeable damage to the surface from frost. The surface on all of the work is in excellent condition, a recent inspection showing only one hole with a surface area of about 0.1 sq. ft. Some slabs have cracked, but less than 4 per cent of the total number laid required attention from this cause. Some of the joints have not been entirely satisfactory in their behavior, however, and it is with the hope that our experience in this connection may prove of value to other localities that this article has been written.

The paving on the main highway is 18 ft. wide, with the exception of six blocks in the town of Oakville, four of these being 50 ft. wide, the other two 30 ft. In addition, the commission built a secondary road 7200 ft. in length on which the concrete is 9 ft. wide. One-course construction was followed, the proportions being 1 part cement, 1½ parts sand and 3 parts crushed limestone. In practically all cases the space between joints is 35 ft.

JOINT MATERIAL

The joint material consists of two layers of bituminated felt inclosing a bituminous filler. Careful measuring of a number of pieces of the material showed an average thickness of a shade less than ¼ in. The behavior of the material under pressure at a laboratory temperature of 69 deg. Fahr. is shown in the accompanying diagram.

In all cases the joints were made by staking the joint material against a 1-in. board. The joints were placed before any concrete was deposited in their vicinity, the boards being carefully staked in a vertical position. The concrete was placed on both sides of the board and the board and stakes removed when the concrete was deposited about 6 ft. beyond the joint. Instructions had been given that special care should be exercised to have the joints vertical on account of trouble having been reported from certain localities where joints had been inclined.

During the season six mixers were employed, but practically all of the concrete was laid by five gangs, this being true of all work done in October and November. The machines were operated over a distance of about 30 miles and the concrete was laid on soils which varied from a light sand to a heavy clay. There were limited areas of quicksand. All of these conditions are named because they prevent the possibility of deciding that some local cause was responsible for the trouble.

When the various sections were opened for traffic no perceptible jar was noticed in passing over the joints, and this condition continued until May 23, 1916. On this day and the following one a decided

unevenness was noted on a number of the joints in widely separated sections of the highway. Through June and well into July there was an increase in the number of joints and in the amount that particular joints were elevated. There was not a regular increase but a variation with the kind of weather. Toward the end of July, however, a maximum was reached, and conditions improved even though the temperature increased. It is of interest to note that the summer and fall of 1915 were unusually wet in this locality and that this condition continued in the spring of 1916, there being almost continuous wet weather



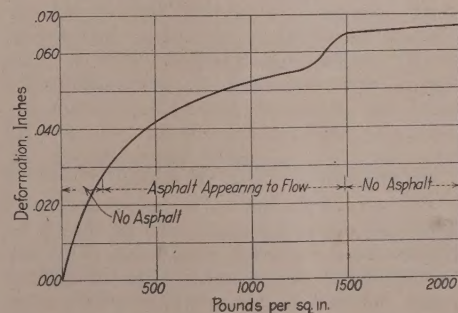
IN NEARLY ALL CASES THE SPACING BETWEEN JOINTS WAS 35 FEET

until June 21. In addition, the spring was unusually cold, the first warm days being May 23 and 24.

6 PER CENT OF JOINTS CAUSE JAR

A careful inspection of all of the 1915 work at the end of August showed that out of a total of 2071 joints, 1944, or 94 per cent, caused no perceptible jar; 85, or 4 per cent, caused a noticeable jar, being up not more than 1 in.; and 42 joints, or 2 per cent, caused a serious jar, some of these being up as much as 2½ in. All of the joints noted as causing a serious jar have been chiseled through, and in every case they were inclined from the vertical. Twenty of the 42 joints were examined soon after the heaving occurred, and in every case water was found in the subgrade beneath the joint.

The most serious heaving was first noted



RESULT OF COMPRESSION TEST OF ASPHALTIC JOINT FILLER

on the heavier grades and on sandy soil which was impregnated with water. The direction in which the mixer worked had a bearing on which side a joint rose, the high slabs being on the side which was farthest from the mixer. The only exceptions so far noted were on the heavier grades and on joints made at the end of a day's work. A comparison of the work done subsequent to Oct. 15 with the entire year's work explains the heaving. It comprised 31.5 per cent of the total year's work, but of 42 joints which heaved seriously 41, or 98 per cent, were in sections that were laid later than Oct. 15, and of 85 joints which heaved noticeably 65, or 76 per cent, were found in them. It was almost possible to tell when certain sections were laid by the behavior of the joints. This was particularly noticeable in the secondary road, which is 9 ft. wide. It was not included in the figures given above. Work was begun on it Oct. 15 and it was completed Nov. 13. The effect of the roadway on traffic is indicated in the accompanying table.

None of the concrete was actually laid when the temperature was below freezing point, but the lowest maximum temperature during any one day in the period from Oct. 15 to Nov. 30 was 33.9 deg. Fahr. During

Beginning with work of Oct. 15 inspection showed the following results at joints ("O.K." meaning satisfactory and "Jar" signifying joint heaved upward):

O.K.	19	Jar.	1	O.K.	1
Jar.	1	O.K.	10	Jar.	2
O.K.	25	Jar.	1	O.K.	1
Jar.	1	O.K.	4	Jar.	1
O.K.	32	Jar.	1	O.K.	1
Jar.	1	O.K.	19	Jar.	2
O.K.	26	Jar.	1	O.K.	2
Jar.	1	O.K.	1	Jar.	1
O.K.	17	Jar.	1	O.K.	1
Jar.	1	O.K.	2	Jar.	1
O.K.	11	Jar.	2	O.K.	4
Jar.	1	O.K.	2	Jar.	1
O.K.	4	Jar.	1	O.K.	4

ten of the days the minimum temperature was below freezing. The lowest temperature during the winter was 9.3 deg. below zero and the highest temperature recorded during the summer of 1916 was 100.2 deg. above zero.

CONCLUSIONS

It is likely that owing to the low temperature at which the concrete was laid, the unusually wet weather which prevailed during the fall of 1915 and the unusually wet and cold weather in the spring of 1916 the concrete did not set up properly. There was not the usual contraction due to the drying out of the excess water of mixing. There may not have been the usual amount of contraction due to the lowering of the

temperature, and there may have been an unusual amount of expansion due to the extremely wet weather. There certainly was not sufficient space between slabs to take care of the expansion due to the increase of temperature in the early summer. Undoubtedly there were contributing causes, as, for example, the lack of verticality in the joints and the tendency of the wet sand sub-base to expand and exert an upward pressure. It may be true that more careful workmanship or an average season would have reduced the trouble, but the same workmanship and weather conditions led to no troublesome heaving in the work done previous to Oct. 15. It would seem, however, that if for special reasons work must be continued late in the fall in sections with climatic conditions similar to our own there should be wider joints provided in the later work, as well as special precautions as to workmanship.

METHODS OF REPAIR

As previously mentioned, the worst joints were chiseled through. In some cases the open space was as great as 4 in. The joints were then filled with a mixture of tar and crushed stone. Where it seemed likely that the slabs might return to their original position the abrupt offset was improved by using tar and pea gravel in such a way as to build up an approach. In some cases this strip was 18 in. in width. Where it seemed likely that there would be no settling back into place the joints were chipped off, the chipping being limited, so that the thickness of the slab was not decreased more than 1 in. All of the minor inequalities were removed in this way with a mason's hammer in a satisfactory manner and at a very low cost.

The length of this article may give an erroneous impression as to the seriousness of the trouble that has been occasioned by the heaving mentioned. At the present time the average user of the highway will not notice any of the joints. There are very few which cause any perceptible jar. In our own case the cost of the repairs made has been a very small part of the cost that would have been entailed in increasing the width of joint to $\frac{1}{2}$ in. on the entire roadway. A wider joint will doubtless increase the cost of maintenance. However, our own experience leads me to feel that an increased thickness of joint material is desirable when the concrete is laid at a temperature approaching the freezing point.

Wind Pressure on Flags Determined

Tests recently made at the U. S. Navy Yard, Washington, D. C., using the largest flags that could be handled in the wind tunnel, form the basis for an empirical formula for determining the pressure of wind on flags for use in designing flagpoles. Two sizes of flags were used—one 3 x $5\frac{1}{2}$ ft., and the other $2\frac{1}{2}$ x $4\frac{1}{4}$ ft.—and velocities varying from 20 to 60 miles per hour were applied. The following formula was found to represent the results, the constant varying but slightly with size of flags, being less for the larger flag:

$$R = 0.0003AV^{1.7}$$

in which R is the resistance in pounds, A is the area of flag in square feet, and V is the velocity of wind in miles per hour. This formula is for steady wind pressure. It was not found practicable to measure the forces produced by wind gusts.

Road and Bridge Expenditures Increase

U. S. Office of Public Roads Publishes Statistics Based Upon Data Collected for 1915

RAPID increase in total expenditures for roads and bridges, growth of building and maintenance activities under State supervision, and a sharp decrease in the proportion of contributions in the form of statute labor mark the development of highway work in the United States during the last twelve years. These facts are brought out by statistics for the year 1915, recently compiled by the Office of Public Roads and Rural Engineering of the U. S. Department of Agriculture.

The total length of public roads in the United States, outside the limits of incorporated towns and cities, was about 2,452,000 miles on Jan. 1, 1916. Of this, about 277,000 miles, or 11.3 per cent, were improved with some form of surfacing. The mileage of surfaced roads has been increasing at the rate of about 16,000 miles a year, and in 1915 approximately one-half of this increase was made under the supervision of State highway departments. In addition, these departments supervised the maintenance of nearly 52,000 miles of main and trunk-line roads.

ANNUAL INCREASE IN EXPENDITURES \$80,000,000

The increase in expenditures for road and bridge work in the United States has been from approximately \$80,000,000 per year in 1904 to about \$282,000,000 in 1915, an increase of more than 250 per cent. The expenditure of State funds during this same period increased from about \$2,550,000 to more than \$53,000,000. In addition, more than \$27,000,000 of local funds was spent under State supervision in 1915, bringing the total road and bridge expenditures managed by the States to \$80,514,699. This amount is greater than the total expenditures for roads and bridges from all sources in 1904.

The growth in importance of the State highway departments has been rapid. The first of these agencies was created in 1891, in New Jersey, and now some form of highway department exists in every State except Indiana, South Carolina and Texas. Since their inception these departments had expended to Jan. 1, 1916, an aggregate of \$265,350,825 in State funds for road and bridge construction, maintenance and administration. They had constructed more than 50,000 miles of roads in co-operation with the States. More than 40,000 miles of these roads were surfaced.

The falling off in the value of road work performed by statute and convict labor was from \$20,000,000 in 1904, when the total road expenditures were \$80,000,000, to about \$15,000,000 in 1915, when the total expenditures had grown to \$282,000,000. This was a reduction from 25 per cent of the total in the former year to less than 5½ per cent of the total in 1915.

INCREASE IN USE OF BETTER TYPES OF ROADS

An increase in the use of better and more expensive types of roads also is shown by the recently compiled statistics. This development has been due, in large part, to the great increase in automobile traffic. It is estimated that there are now approximately 2,500,000 automobiles in use on the roads of the country, or one car for every mile

of road. This present motor traffic is in excess of traffic of all sorts twelve years ago.

The cash road and bridge expenditures of the United States averaged only \$28 per mile of rural roads in 1904. In 1915 this average had grown to \$109 per mile. New Jersey led all other States both in 1904 and in 1915, with \$221 and \$475 per mile respectively. Nevada made the least expenditure in both years—\$3.72 per mile in 1904 and \$17 per mile in 1915.

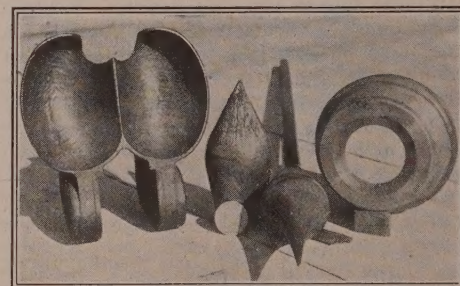
Water Will Wear Even Steel

Parts of Waterwheel Subjected to 1960-Foot Head Show Considerable Erosion After Eighteen Months of Service

By V. W. KILLICK
Glendale, California

THE great erosive effect of water on parts of a waterwheel is shown by the accompanying photograph. The needle, valve-seat and bucket were taken from a Doble wheel after having been subjected continuously for a period of eighteen months to receiving 375 miner's inches of water at the bottom of a 1960-ft. drop.

The Doble wheel was installed in power



WEAR ON WATERWHEEL PARTS AFTER EIGHTEEN MONTHS UNDER HIGH HEAD

house 2 of the Southern California Edison Company, in the mouth of Mill Creek canyon, near Redlands, Cal. The electric current generated at this plant is derived from the water power of Mill Creek. Part of the waters of the creek are diverted from their natural course about 3 miles above the power house and are piped to a reservoir on a high cliff nearly 2000 ft. above the plant, from which cliff the water has almost a vertical fall into the waterwheels.

Although the water is thoroughly strained so that it contains less than 0.1 per cent of solid matter, it has, during the short time mentioned, eroded the nickel-steel needle to the extent shown in the picture. The surface of the bucket is also considerably indented. For comparison a new needle is shown, and a silver dollar in the picture gives the relative size of the parts. When installed the needle fits into the valve seat shown on the right, and the water is turned into the wheel by screwing up the needle, leaving a space between it and the valve-seat.

Dam Work on Kentucky River Will Be Completed by November

With the completion of dam 14, probably in November, the entire system of dams on the Kentucky River will have been completed and that river put in navigable condition from its source to its mouth. Repairs to dam 2 necessitated by flood damage in 1913 have recently been finished at a cost of about \$34,000.

Selecting Economical Type of Riveted Joint for Steel Pipes and Standpipes

Tables and Diagrams Developed as Result of Investigation to Determine Proper Design for Pipe Line—Effect of Efficiency of Joint on Economy

By FRANK H. CARTER
Designing Engineer, Cliftondale, Mass.

WHILE attempting to select the proper type of joint for a 54-in. riveted steel pipe line about 2800 ft. in length under 475-ft. head early in 1913, under the direction of Henry F. Bryant, consulting engineer, of Brookline, Mass., through whose courtesy the writer is enabled to publish that part of this paper relating to pipe lines, it was found that little or nothing had been written on the question of the relative economies of the different kinds of riveted joints.

The vital point in the construction of a riveted container made of plates, whether for water, steam, or air, and whether the structure be a vertical standpipe, horizontal pipe line, a steam boiler or an air tank, is the design of the joint. As the thickness of plates which must be used depends largely on the efficiency of the joint, the selection of the proper type of joint, with due regard to the differences in the costs of the various types, is obviously the principal factor in the determination of the greatest economy of design; an increase in the efficiency of the joints means a saving in the thickness of metal required.

RIVETED STEEL PIPE LINES

The average efficiencies of the several types of joints considered is approximately as given in Table 1. An attempt was made to ascertain the cost of these several kinds of joints by inquiry among boilermakers located near Boston, but with little success, except in the case of one prominent maker who wrote that the comparative costs of the joints might be broadly stated as given in Table 1 under "Relative Cost."

TABLE 1—VALUES FOR VARIOUS TYPES OF JOINTS

Type of joint	Efficiency	Relative cost	Cost per 100-ft. head
Single-riveted lap joint.....	0.576	100	\$6.00
Double-riveted lap joint.....	0.739	170	4.63
Triple-riveted lap joint.....	0.750		4.36
Double-riveted butt joint.....	0.820	330	4.33
Triple-riveted butt joint.....	0.875	520	4.12
Quadruple-riveted butt joint...	0.937	570	3.94

These values are as close as this manufacturer could give because of the scarcity of available information on the subject. A check was obtained from the statement of another of Boston's prominent boiler manufacturers that he estimates about \$12 to \$18 as the increase in cost of one type of joint over another for a boiler 18 ft. long; that is, a quadruple-butt joint costs from \$12 to \$18 more than a triple-butt joint.

COST BASED ON WEIGHT

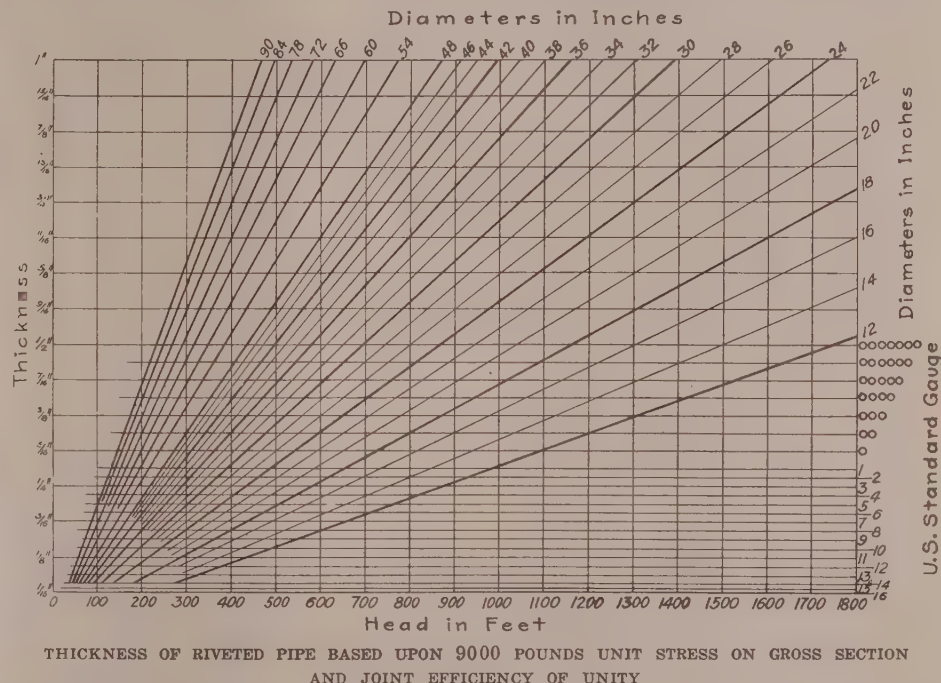
The only recourse left was to compute the weights of the different joints at some considerable labor and to estimate the relative costs from the weights alone, without regard to any other factor, notwithstanding the fact that the labor cost of a joint may vary more rapidly than the comparatively few extra pounds of metal involved in substituting, for instance, a quadruple-riveted butt joint for a double-riveted lap joint. As the diameter of the penstock

increases, the requirement that the most efficient joint be selected to insure maximum economy is more apparent, and the question of increased labor cost with increased number of rows of rivets is of smaller moment. Hence any question as to the extra labor or material cost involved in the more complicated joints over and above the more simple joints is vastly ex-

ness of pipe. In fact, practically the essence of this paper is found in the cost per 100 ft. of allowable safe static head given in the last column of Table 1, which was computed on a basis of $\frac{1}{2}$ -in. plate for a pipe of 54-in. diameter, using 10,000 lb. per square inch as the safe unit stress on the net section, with no other allowance for corrosion or for water hammer. This is practically equivalent to assuming 16,000 lb. per square inch unit stress on net section with 100 lb. per square inch assumed water hammer at the wheels and an allowance of $\frac{1}{16}$ -in. thickness for corrosion.

COMPARATIVE DIAGRAMS

The fact that these two methods are so nearly equivalent is shown in an accompanying diagram. The upper line repre-



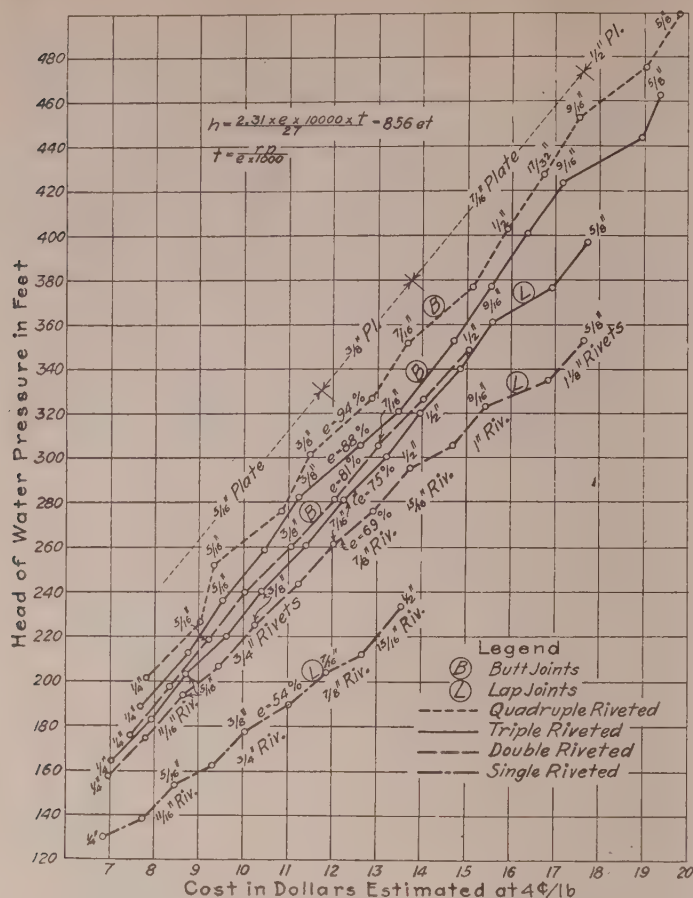
ceeded by the saving in thickness of metal for the pipe itself.

Tables were computed for a pipe 54 in. in internal diameter with roundabout seams every 72 in. The weight of the lap and rivets required to make up the roundabout seams was computed, and also the ratio of the total weight of lap and rivets to the weight of 72-in. length of the "barrel" of the pipe plus the weight of the necessary straps or laps, as the case might be. This ratio was added to the overweight percentage and applied to the weight of the pipe per foot, including straps or laps, after which the weight per foot of the rivets was added to make up the total estimated weight of the pipe per foot complete. A price of 4 cents per pound was used to estimate the cost of the pipe. From data furnished the writer from time to time, through the courtesy of E. E. Lockridge, chief engineer of the Springfield Water Works, on the cost of laying 42-in. lock-bar pipe it was estimated that it would cost \$0.186 times the diameter of the pipe in feet to lay the pipe in the trench and field-rivet and calk it in approximately 30-ft. lengths.

A summary of these tables is shown in Table 2, where the weight per linear foot, the cost per linear foot delivered along the trench and the allowable static head computed on a basis of 10,000 lb. per square inch net section are given for each thick-

sents the allowance of 100 lb. water hammer at the lower end of the pipe at the power plant, assuming the water hammer to be practically nothing at the upper and open end of the pipe at the equalizing tank. This line is drawn 23 lb. higher than necessary for the water-hammer allowance to provide for the $\frac{1}{16}$ -in. extra thickness of pipe allowed for corrosion. The horizontal line at El. 1020 marks the full reservoir, while El. 990 is minimum low water. The line next below is drawn to represent the hydraulic gradient with the 54-in. pipe flowing full. The slanting line is a diagrammatic illustration of the profile of the pipe line itself. This is not strictly correct, as the true profile is not a straight line; but the straight line will answer as well as the true profile to illustrate the point that an allowance of 10,000 lb. on the next section is well within the truth and is probably as close a method of determining the proper thickness of pipe as any which might be devised.

Computations of thickness of pipe for an allowance of 16,000 lb. on the net section with 100 lb. water hammer at the lower end and an allowance of $\frac{1}{16}$ in. extra throughout for corrosion are shown on the upper side of the lowest slanting straight line, which represents the profile of the pipe line, and may readily be compared with a similar scale drawn along the bottom of the same straight profile line, and



COST OF STEEL PIPE WITH DIFFERENT TYPES OF JOINTS

Based upon design of pipe of 54 inches diameter at 10,000 pounds per square inch on net section, thickness $t = rp/10,000e$. Butt strap thickness given in topmost line.

computed on the basis of 10,000 lb. per square inch on net section, with no other allowance either for corrosion or for water hammer. The latter method automatically cares for the assumption that water hammer decreases from a maximum at the wheels to practically zero at the upper end of a pipe line which is open at the upper end. At first thought 10,000 lb. on the net section, after deducting the proper amount for loss in efficiency due to joints, seems absurdly low. It is a fact, however, learned from an examination of the files of current engineering publications that many pipe lines in the Western states have been designed for a stress of from 6000 to 7500 lb. unit stress on the gross section.

RELATIVE ECONOMY

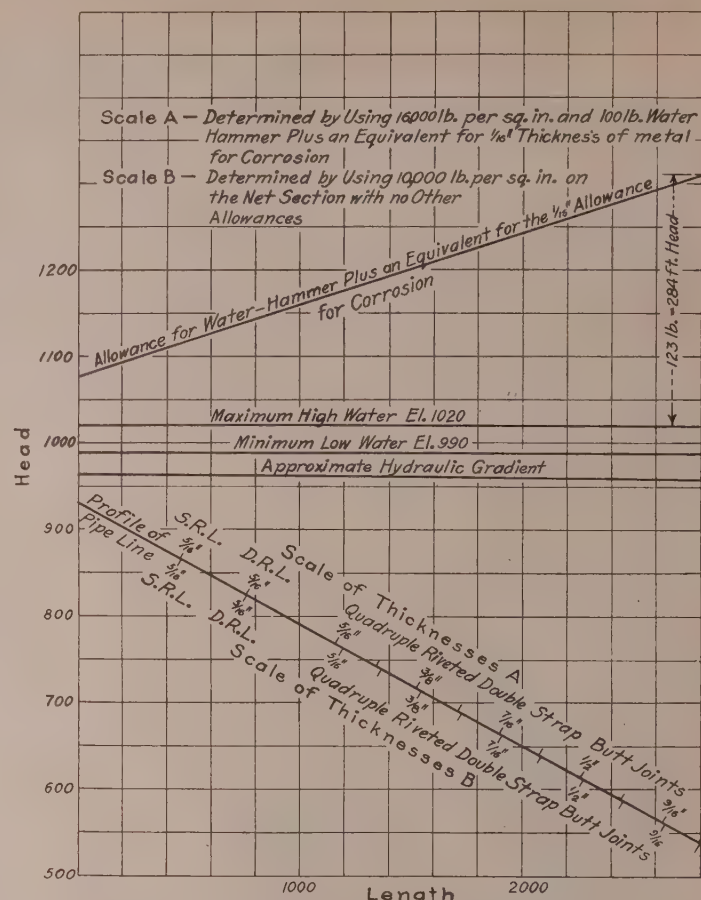
The relative economy of the different types of joints is perhaps more clearly illustrated by means of the curves given in the diagrams than by means of the tables. The quadruple-riveted butt joint is clearly the cheapest type of riveted joint, while the very poor economy of the single-riveted lap

joint is obvious. Thus \$1,000 will purchase 84.5 ft. of 7/16-in. single-riveted lap joint steel pipe at \$11.85 per linear foot, or \$1,000 will purchase 128 lin. ft. of 1/4-in. quadruple-riveted joint steel pipe at \$7.80 per linear foot, both of which will safely stand a static head of about 202 ft. at 10,000 lb. per square inch on the net section. No doubt the actual increased labor cost of a 54-in. quadruple-riveted butt joint over that of a single-riveted lap joint would bring these figures somewhat nearer together, but for larger diameters the actual saving effected by the use of the more complicated joints is very apparent.

The diagram on page 467 illustrates a method by which riveted steel pipe lines may be quickly laid out for approximate estimates of cost. It is well known that the thickness of a steel pipe line is determined by the formula

$$t = \frac{rp}{es}$$

where t is thickness of pipe required in fractions of an inch; r , the internal radius



RELATIVE THICKNESS FOR RIVETED STEEL PIPE LINES

Different assumptions made in methods of computation are indicated on the diagram.

of the pipe in inches; p , the internal water pressure on the pipe in pounds per square inch; e , the efficiency of the joint as compared with the gross section of the plate; and s , the allowable working stress on the net section in pounds per square inch of metal. To use the diagram, bear in mind that s is 9000 and e is 1.00 for the values given; hence, to find the safe head in feet for any pipe of given diameter for any value of e other than unity and any other value of s than 9000 lb. per square inch, multiply h as read from the diagram by $se/9000$.

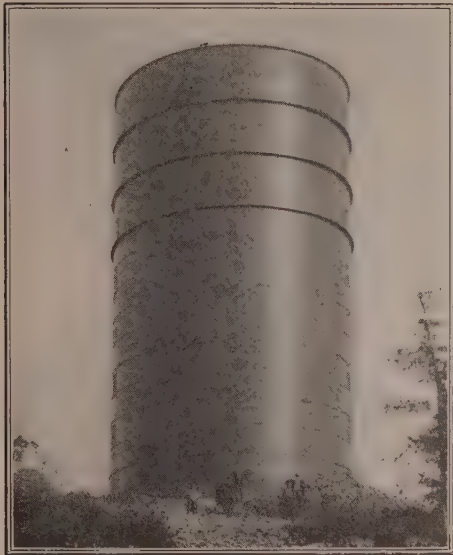
For instance, suppose it is required to determine the safe head which a single-riveted lap joint 54 in. in diameter pipe with 1/2-in. thickness will stand, assuming 10,000 lb. as the safe working unit stress on the net section. Entering the diagram at the 1/2-in. line at the left, and running horizontally to the inclined line, marking a diameter of 54 in., we read 385 ft. as the safe head. By the rule just given we must multiply this value by $10,000 \times 0.576/9000$, and the head required is 245 ft., which in

TABLE 2—WEIGHT, COST AND SAFE STATIC HEAD FOR 54-IN. RIVETED STEEL PIPE

Thickness	WEIGHT—POUNDS PER LINEAR FOOT						COST—DOLLARS PER LINEAR FOOT						ALLOWABLE STATIC HEAD IN FEET					
	Lap joints			Butt joints			Lap joints			Butt joints			Lap joints			Butt joints		
	Single	Double	Triple	Double	Triple	Quadruple	Single	Double	Triple	Double	Triple	Quadruple	Single	Double	Triple	Double	Triple	Quadruple
1/4	172.4	174.0	176.6	185.9	192.5	195.6	6.90	6.95	7.05	7.45	7.70	7.80	130	158	165	176	189	201
9/32	193.4	194.9	198.1	208.8	220.4	208.0	7.75	7.80	7.95	8.35	8.80	9.05	137	175	183	198	213	227
5/16	212.2	214.3	217.2	230.8	239.0	234.1	8.50	8.65	8.70	9.25	9.55	9.35	153	194	203	219	236	252
11/32	233.1	236.4	240.4	250.9	262.3	272.1	9.35	9.45	9.65	10.05	10.50	10.90	162	207	220	240	259	276
3/8	251.7	256.0	260.9	277.4	281.3	288.2	10.10	10.25	10.45	11.10	11.25	11.50	177	225	240	260	283	302
13/32	277.6	281.2	285.9	302.3	317.2	324.2	11.10	11.25	11.45	12.10	12.65	12.90	189	243	261	282	306	327
7/16	296.7	300.7	306.0	325.9	336.8	342.3	11.90	12.05	12.25	13.05	13.50	13.70	204	262	280	306	330	352
15/32	317.4	324.7	331.0	350.5	369.3	379.5	12.70	12.95	13.25	14.05	14.75	15.20	212	277	300	327	353	377
1/2	339.0	344.9	350.1	376.2	388.9	398.6	13.60	13.75	14.00	15.10	15.55	15.95	226	296	321	349	377	402
17/32	368.3	371.3	374.3	409.5	418.7	427.8	14.75	14.90	15.15	16.40	16.75	17.15	306	366	391	424	457	487
9/16	386.4	390.4	394.4	428.6	437.8	447.9	15.55	15.80	16.05	17.20	17.55	17.95	324	384	409	442	475	505
19/32	421.1	424.4	427.7	473.0	476.1	485.2	16.85	16.95	17.15	18.95	19.05	19.25	335	377	402	444	476	505
5/8	442.8	444.0	445.2	482.7	485.2	495.2	17.75	17.75	17.75	19.35	19.80	19.80	353	397	422	468	498	527

this case may be checked by referring to the other diagram.

The saving in total weight of metal by using joints of high efficiency for standpipes, especially those of large diameter, is very marked. For instance, in the case of a standpipe 40 ft. in diameter and 100 ft. high, assuming an efficiency of 93.7 per cent for quadruple-riveted butt joints, a saving in the weight of metal of approximately 10,000 lb. was effected. It has been demonstrated that the economical riveted joint for riveted steel pipes, boilers and standpipes, at least those 54 in. in diameter or greater, in so far as the economy is to



CLIFTONDALE STANDPIPE IS 45 FEET IN DIAMETER AND 85 FEET HIGH

be determined by the *weight*, is that of the highest efficiency.

The standpipe at Cliftondale, Mass., built by the Chicago Bridge & Iron Works and shown in the accompanying view, was designed according to the method indicated in this paper.

Illinois Highway Commission Gives Rules for Dragging

Illinois has a large mileage of earth roads. For that reason proper dragging is a matter of great importance. The following are a number of rules given by the State Highway Commission as an aid in accomplishing the best results:

Use a light drag.

Haul it over the road at an angle so that a small amount of earth is pushed to the center of the road.

Drive the team at a walk.

Ride on the drag; do not walk.

Begin at one side of the road, returning up the opposite side.

Drag the road as soon after every rain as possible, but not when the mud is in such a condition as to stick to the drag.

Do not drag a dry road.

Drag whenever possible at all seasons of the year. The width of traveled way to be maintained by the drag should be from 18 to 20 ft. First drag a little more than the width of a single wheel track, then gradually increase until desired width is obtained.

Always drag a little earth toward the center of the road until it is raised from 10 to 12 in. above the edges of the traveled way.

If the drag cuts too much, shorten the hitch.

The amount of earth that the drag will carry along can, to a very great extent, be controlled by the driver, depending on whether he stands near the cutting end or away from it.

When the roads are first dragged after a very muddy spell the wagons should drive, if possible, to one side until the roadway has a chance to freeze or to partly dry out.

The best results from dragging are obtained only by repeated application.

British Standardization Aids Industries

History, Organization and Methods of Engineering Standards Committee Outlined and Its Industrial Importance Emphasized

CONVINCING EVIDENCE of the value and national importance of the work being done by the Engineering Standards Committee, in the work of which are engaged some 500 members of the five leading engineering institutions of Great Britain—the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Naval Architects and the Iron and Steel Institute—is presented in a paper read Sept. 7 before the British Association by the secretary of the committee, and published in *Engineering*. The following extracts may be of interest to engineers in this country, particularly with reference to the parallel work being done here by the American Society for Testing Materials. The value of standardization, the effect on quality of product, the history and growth of the British committee, its internal organization and the success of the movement are discussed in detail.

VALUE OF STANDARDIZATION

"It is scarcely necessary nowadays to insist on standardization as being of paramount importance to economic production, but that was not so clearly seen sixteen years ago, before the advent of the British Engineering Standards Committee. However, keen competition from outside, the legitimate demands of labor for a higher standard of living, coupled with the desire of capital for an adequate return, have compelled the whole industry to introduce modern order and system in all its methods of production, former individualistic methods giving way to co-ordination and collective effort. These improvements, which have already resulted in marked benefits, must not only be maintained, however, but continually added to if the full advantages are to be reaped.

REVISION NECESSARY

"Crystallization, however, which would tend to impede and to stultify progress, must be jealously guarded against if standardization is to be of permanent value and the purchaser is not to be deprived of the benefit of competitive effort and inventive genius. Those responsible for the initiation of the standardization movement in Great Britain realized from the first that in order to avoid undesirable stereotyping of practice it would be necessary from time to time to revise standards.

"Satisfactory results have been arrived at not by one section of the community imposing its opinions on the other, but rather as the result of co-operative action, mutual concession and ultimate agreement among all the interests concerned. The adoption of standards agreed on in this way undoubtedly promotes uniformity of practice, avoidance of waste, elimination of harsh and unnecessary conditions, reduction of manufacturing costs, and last, but by no means least, engenders a feeling of mutual confidence between user and producer such as could not be secured by isolated action on the part of either.

"Experience, moreover, has shown clearly that such procedure does not lower the standard of quality, but tends rather to raise it, for standardization carried out

along these lines reflects, in effect, the consensus of opinion as to what constitutes best modern practice.

"Successful standardization can only be arrived at by common consent of all those who take full part in the initiation and working out of the actual details of the various specifications which are intended to be recommended ultimately for public use. The realization of this guiding principle by the founders of the Engineering Standards Committee is probably one of the chief reasons for the wide adoption of the British Standard Specifications, which have no authority other than that of public opinion.

INCEPTION AND GROWTH OF COMMITTEE

"The movement, as represented by the Engineering Standards Committee, the greatest voluntary effort of its kind, in which public spirit has been so lavishly shown, was founded in 1901, through the initiative of Sir John Wolfe Barry, K.C.B., who had long been coming to the conclusion that some means were urgently required to systematize design and production of component parts. In January, 1901, he laid the matter as affecting the engineering trades of the country before the council of the Institution of Civil Engineers, with the result that a committee was appointed to consider the question of standardizing various kinds of iron and steel sections. The committee reported favorably on the project, and the council of the Institution of Civil Engineers adopted the report, and the co-operation of the five leading engineering institutions of the kingdom was subsequently secured.

"Thus from a single committee, consisting originally of seven members, appointed to discuss the advisability of standardizing rolled sections and rails, has grown the present far-reaching organization with its sixty-four committees and subcommittees, as well as numerous panels, including, in all, well over 500 members freely giving their time and experience, often at great personal inconvenience, and dealing with subjects embracing practically the whole engineering practice.

INTERNAL ORGANIZATION

"The internal organization of the Engineering Standards Committee need only be very briefly referred to, as it is fully set out in the report on work accomplished, which is issued annually. The main committee, which is composed of nineteen official representatives of the five leading engineering institutions, has charge of the administration of the whole of the work, the raising of the necessary funds, the controlling of the expenditure, the selection of subjects for standardization, and the ratification of all reports and specifications presented by the various sectional committees for its approval prior to publication. The sectional committees are appointed by the main committee, who nominate the respective chairman and arrange the mode in which the subjects are to be dealt with. The sectional and subcommittees contain representatives of the various government departments, consulting engineers, manufacturers, contractors and users, as well as

representatives from the technical societies and trade associations concerned."

A diagram, not reproduced here, shows the relation of sectional committees, sub-committees and panel committees to the main committee. The sectional committees are: Bridges and general building construction; sections and tests for materials used in ships and their machinery; railway rolling stock underframes; locomotives; cement; electrical; pipe flanges; rails; furnace; publication and calculations; cast-iron pipes; vitrified ware pipes; automobile parts; rope pulley grooves; screw threads and limit gages; wire ropes; road material, and galvanized corrugated-iron and steel sheets.

"The main committee only studies subjects at the request of the various sections of the industry concerned, and does not venture to make recommendations except on the initiative of the engineers or responsible representatives of the trade affected. The utmost care is taken at the very outset to insure that all who have or could possibly have any interest in the proposed standardization shall be adequately represented (through their recognized societies and trade associations, if such exist) on the committee intrusted with the work. If necessary, evidence is taken, the advice of experts is sought, and in this way all parties are consulted and have a voice in the initial proposals, thus avoiding much subsequent friction which might otherwise occur.

EXPERIMENTAL WORK

"In drawing up industrial standards, experimental investigations frequently become necessary in order to establish the facts underlying the principles involved, and in this connection the National Physical Laboratory has been and is conspicuously useful. It is in effect the committee's official testing bureau, and its ultimate authority in matters concerning electrical and mechanical tests, acting in an advisory capacity in all the work in which unbiased experimental data are essential.

"Each sectional committee is given an opportunity, once a year, of passing in review the specifications for which it has been responsible, for possible revision or addition if experience shows that such is desirable, and it is this system of keeping abreast of invention and progress which adds so greatly to the practical value of the work of the committee.

"The British Standard Specifications, which are confined to the main technical clauses necessary for the purchase of the product to which the specification relates, find an increasingly wide adoption. They are being increasingly adopted throughout the country, in home and export trade in general."

SUCCESS OF MOVEMENT

That the efforts at standardization have been successful is demonstrated by the complete statement given in the paper to show the results already accomplished. For example, of these results directly relating to the field of the civil engineers there are cited: The number of rolls in use by British manufacturers have been largely reduced; formerly 70 sections of tramway rails were rolled; these have been reduced to 5. A similar reduction has occurred for all ordinary sections, such as angles, tees, channels and beams. The British Standard Specification for Portland cement is now generally adopted by engineers and manu-

facturers throughout the whole country, probably 75 per cent of the total output conforms to this standard; and the London County Council has required that all rolled steel used in the construction of skeleton frameworks of buildings must comply with the British Standard Specifications, and that all cement used must conform to the British Standard.

Tablets Set in Concrete for Coast Survey Stations

Name or Number of Benchmark and Date Established Stamped on Center—Inscription Explains Point

SO THAT engineers and surveyors may stake advantage of U. S. Coast and Geodetic Survey benchmarks and stations, tablets have been issued by the government for use by the engineers of the Survey. Each tablet is set in concrete or some kind of masonry structure and tells the nature of the station.

Directions for using the new devices state that "wherever a triangulation, reference,



NEW TRIANGULATION STATION TABLET

topographic or hydrographic station or a leveling or tidal benchmark is established and marked with the standard inscribed metal disk or cap, the disk or cap should be stamped with the name of the station or the number of the benchmark. There should also be stamped the year in which the station or benchmark is established. If a station or benchmark is recovered which had been marked with an inscribed disk or cap, the name or number and the date when originally established should be stamped. Also, when a recovered station or benchmark which had not been marked with a disk or cap is remarked with a disk or cap the name or number and the date of original establishment should be stamped.

"When a new or recovered magnetic station is marked with a disk, the year in which the station was established should be stamped on the disk. It is not necessary to stamp the name of the mark of a magnetic station.

"The only exception to this general rule should be when the stamping cannot be done except at excessive cost or delay to the work or when to stamp the mark would loosen or destroy it."

Give Elevations of 1000 Points in State of Mississippi

The elevations of more than 1000 points in Mississippi are given in Bulletin 639, recently published by the U. S. Geological Survey. The highest point noted in the report, but not the highest point in the state, is in the Iuka quadrangle, Tishomingo County. The highest point located in Mississippi is a few miles southwest of Iuka, where an unnamed summit rises to a height of 780 ft. above sea level.

Well-Made Concrete Tanks Affected by Few Fluids

Lard Oil, Sulphite Liquor, Cider Vinegar, Molasses and Brine Are Found to Disintegrate the Surface

RESULTS of tests made for the Portland Cement Association to determine the effects of commercial liquids on concrete tanks, extending over a period of at least thirteen months, and in some cases over longer periods as supplementary studies, have been reported by the Institute of Industrial Research, Washington, D. C. In most cases it was found that plain untreated concrete of good mixture, properly placed, resisted the action of the various liquids used in the tests just as well as the concrete given special treatment. Certain substances caused marked disintegration, although at the present time the data available are not considered complete for these materials. For example, it is claimed in some quarters that molasses has not been found to affect concrete tanks, and in other cases that concrete brine tanks have stood well under the disintegrating action of a concentrated brine solution.

CONCRETE NOT AFFECTED

In the case of the following fluids, plain dense concrete of 1:2:4 mix was found after thirteen months to be practically uninjured: Menhaden oil, linseed oil, rosin oil; 4 per cent caustic soda solution; tanning solution, and sauerkraut. The use of special treatments of the inside surface gave no better results than plain concrete for these materials.

On the other hand, it was found that plain concrete was affected by lard oil, sulphite liquor and cider vinegar. Lard oil softens the surface of the concrete and exposes the aggregate, and no satisfactory special treatment to prevent this action has yet been reported. Sulphite liquor lays bare and loosens the coarse aggregate under a progressive action that makes it unsafe to use untreated concrete for storage of this liquid. In a supplementary report it is stated that the only satisfactory method of protecting concrete from disintegration by sulphite liquor yet found is by surface treatment with a paint coat of blown oil-gilsonite compound. A concrete tank treated with such compound has now been used successfully for the storage of sulphite liquor for a period of 15 months and is at the present time in perfect condition. No other treatment than that just noted has prevented disintegration.

ACID PROTECTIVE PAINT

This blown-oil gilsonite compound should be applied as follows: Dissolve 100 parts by weight of Utah asphalt (gilsonite) in 250 parts of turpentine. At ordinary temperature, 24 hours will be required for perfect solution, stirring frequently. A perforated metal basket in which to suspend the broken lumps of asphalt in the solvent will accelerate solution. Add 5 parts of neutral petroleum oil. Two coats should be applied with a brush, allowing at least 24 hours for the drying of each coat.

Cider vinegar attacks the concrete in exactly similar manner to the sulphite liquor. In a supplementary report, it is stated that the remarks relative to sulphite liquor are applicable to the tests made with cider vinegar. The blown oil-gilsonite compound has been in use for a period of 15 months,

and as the surface treatment caused no injury to either concrete, coating or vinegar, it may be said that vinegar may safely be stored in concrete tanks if so protected. It was found that an application of two coats of paraffin dissolved in benzol gave better results than plain concrete, but was not entirely satisfactory.

EFFECT OF MOLASSES

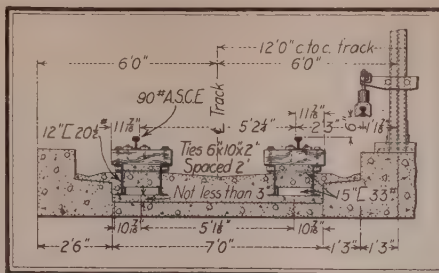
Molasses, according to a supplementary report, can be prevented from affecting the concrete by using proper varnish. At the end of 16 months' test a concrete tank covered with two coats of Bakelite varnish has proved absolutely satisfactory for storing molasses. This is the only test that has been made in which neither the concrete, coating nor molasses has been injured. It may therefore be said that molasses may safely be stored in concrete which has been properly protected by the application of two coats of Bakelite varnish.

Similarly, it is reported that concentrated brines from the manufacture of salt had no injurious effect on a concrete tank coated with two layers of gilsonite compound between which was placed asphalt burlap fabric, also covered with a heavy coat of gilsonite. Upon this was placed a 1:2 cement mortar coating and facing, and two coats of Bakelite. In the report it was suggested that probably as good results could be obtained by omitting the asphalt felt and using instead a swab coat of blown-oil gilsonite compound, after painting with a printing coat of the same material thinned with gasoline. Upon this a layer of burlap fabric and two swab coats of the compound should be placed, then the cement mortar and Bakelite treatment applied as described.

Unballasted Subway Track Proves Economical

Ten Years' Experience in Philadelphia with Ties on Concrete Bed Shows 50 Per Cent Lower Maintenance Cost

NEARLY ten years of severe service of unballasted track in the Philadelphia subway have satisfied William S. Twining, director of the department of city transit, Philadelphia, and chief engineer of the Rapid Transit System at the time the track was laid, of the economy and desirability of that type of construction. He discusses the subject in a recent issue of the *Electric Railway Journal*. Except on curves, where there had been rail renewals, the track is



TYPICAL CROSS-SECTION OF PHILADELPHIA UNBALLASTED TRACK CONSTRUCTION

still as originally laid, while ballasted track on the Market Street elevated line, laid at the same time with the same type of rail and joints, required extensive rail and tie renewals in 1912 and 1913. Taking into account maintenance, Mr. Twining estimates a 10-per cent lower cost per mile for the unballasted track.

The first section of the unballasted track, the construction of which is shown in the accompanying cross-section, was placed in operation in February, 1907, and has been in continuous use since that date. The same rail and construction throughout as originally laid is still in service with the exception of the rail on curves, and probably the rail on tangents will have a life of about a year and a half more. During this period approximately 3,500,000 cars have used the track, or a tonnage of about 140,000,000.

COMPARISON OF TYPES

As there is no ballasted construction on any of the subway tracks in Philadelphia, the nearest approach to a comparison of maintenance costs between the ballasted and the unballasted type of construction is afforded by the tracks of the Market Street elevated line immediately west of the subway. These were laid at the same time with precisely the same type of rail and similar joint plates. The elevated construction consists of 6 x 8-in. by 8-ft. ties on stone ballast with a depth of from 5 to 8 in. beneath the ties. The rail on the elevated structure was in such condition in 1912 as to demand renewal throughout the entire section between Twenty-ninth and Sixty-third streets. This was done late in 1912 and early in 1913, after a life of six years, and during 1912 and 1913 the greater part of the ties were likewise renewed.

Comparative yearly costs per mile are given in the accompanying table, and show a difference of \$354 per mile per year in

favor of the unballasted construction. The life lengths of the rail are based on actual experience in Philadelphia. There is no information at hand as to how long untreated ties will last in the subway, but the present ties are in first-class condition after nearly ten years of service, and their life length has been placed at fifteen years. The ties in each case are untreated.

Other advantages of the unballasted construction given by Mr. Twining are the cleanliness of the subway and the additional room obtained for the storage of material for repairs or renewals. The matter of cleanliness, it is pointed out, is very important. The floor is practically a grano-

COMPARATIVE COSTS OF UNBALLASTED AND BALLASTED CONSTRUCTION

Unballasted Construction	
Interest on initial cost (\$44,352 at 5 per cent)	\$2,218.00
Sinking fund for tie renewals (\$4,224 in fifteen years)	192.00
Sinking fund for rail renewals (\$6,336 in ten years)	496.00
Maintenance	528.00
Total yearly cost per mile	\$3,434.00
Ballasted Construction	
Interest on initial cost (\$24,288 at 5 per cent)	\$1,214.00
Sinking fund for tie renewals (\$5,808 in eight years)	600.00
Sinking fund for rail renewals (\$6,336 in six years)	918.00
Maintenance	1,056.00
Total yearly cost per mile	\$3,788.00

lithic surface, which can be cleaned either by flushing with water or by sweeping with ordinary brooms, both of which methods have been used effectively and to such an extent that absolutely no foreign matter of any description has been allowed to remain. The track space of station platform is swept up each night during night traffic, and the other portions of the subway are cleaned at frequent intervals.

In conclusion Mr. Twining states that after nearly ten years of service there is no hesitancy in saying that the aims of the designers have been fully realized, and that no defects have been indicated that would suggest any desirable changes in the method of construction.

Record Grade for Concrete Pavement

So far as is known, the steepest grade upon which concrete has been used is in Los Angeles. The Portland Cement Association has recently distributed a photographic reproduction of Baxter Street in that city, where grades range from 11 to 29 per cent.



COMPLETED UNBALLASTED TRACK IN PHILADELPHIA SUBWAY, AND SAME IN COURSE OF CONSTRUCTION, WITH STEEL EXPOSED

American Engineers for Canadian Work

Two Contrasting Views Presented of Controversy Arising from Choice of Head for Government Valuation of Railroads

TWO contrasting views have reached this journal from Canada relative to the appointment of Prof. George F. Swain to take charge of the government valuation of the Canadian railways and the circular of protest issued by the Canadian Society of Civil Engineers. R. A. Ross, consulting engineer, of Montreal, in a letter to the editor of the Engineering Record, holds that the action of the Canadian Society is in no way a reflection on Prof. Swain, nor even on American engineers, but is the beginning of a campaign to force the Dominion's lawyer-politicians to recognize the Canadian engineers. He points to the exclusion by law of Canadian engineers from American governmental affairs, and insists that in self-defense Canadians must fight against free trade that works one way only. Another side of the matter is presented by the *Toronto Mail and Empire*, which, quoting from a government memorandum in answer to the circular and from statements by Sir Henry Drayton of the special commission, points to the necessity for getting the best man for a work of such magnitude and to the scarcity of Canadian engineers at once qualified by experience to take charge of the investigation and unaffiliated with any of the properties to be investigated.

R. A. Ross' Letter

Mr. Ross' letter is as follows:

"I have read with a great deal of interest the editorial in your issue of Sept. 23, page 369, dealing with the circular recently issued by the Canadian Society of Civil Engineers relative to the appointment of Prof. Swain as engineering adviser to a commission recently formed by the Canadian government for the study of the railway problem in this country. Your editorial is unexceptionable both in spirit and tone and affords the opportunity Canadian engineers desire to place their position before the engineering fraternity in the United States.

"As regards the case in point, it is one of a series of similar appointments made by the Dominion and provincial governments which have hitherto called forth merely desultory criticism by individual members of the society.

THE BEGINNING OF A CAMPAIGN

"In this case (a particularly flagrant one in the opinion of all) it was decided that united action should be taken, not, be it noted, so much against American engineers as such, nor at all against Prof. Swain, but against the government's total neglect of Canadian engineers. The action is intended as the opening gun of a campaign to force a recognition of the engineer on our lawyer politicians.

"In dealing with the matter we first met Prof. Swain at a small dinner in his honor in Montreal, and laid before him our intended program, in which his case was a mere incident, pointing out that we had no criticisms to offer as to his attitude, as we would all be ready to act for the government of the United States should that government decide to call in Canadian engineers for advice—a thing, by the way, which has never happened and never can

happen, owing to the legislation against such appointments to which you refer in your editorial.

ETHICS AND PLAIN LIVING

"Your editorial deals with the Canadian engineers' action on a high ethical plane. We entirely agree with the ethics of high thinking and plain living, and have held that position up till recently without complaint, although the plain living has become plainer, especially during the last three years; but at last we have awakened to the fact that the game is not played in that way, and that the admonition is not for practical use, but only for application to others—and we apparently are the others.

"The Canadian engineer is not surrounded by carefully constructed wire entanglements of defensive laws, and has had to fight in the open against all comers—and they have come in recent years in ever-increasing numbers. We are therefore in the position of a nation of avowed free traders who find that the other fellows are protectionists, and that in order to obtain, not the free trade which they desire and have always upheld, but merely a fair trade, they must take such action as will provide at least the less desirable alternative.

"How far we may ultimately find it advisable to go in the direction of much disliked protection we do not know, but the present situation is not as yet connected with a demand for legislation, being designed merely to discourage the calling in of outsiders where such necessity does not exist. As a matter of fact, the engineer in this as in other countries resents his position under the domination of the politician and proposes to make himself felt, and with this view you will be in entire sympathy and rejoiced to know that we are at last alive and kicking.

LITTLE CRITICISM OF THE CIRCULAR

"Your interest in the question of the reception accorded the circular will be satisfied when you know that the decision of the council was unanimous, and as to the membership in general the only criticisms we have heard are from four United States members, all directed along the lines of your editorial. This unanimous approval of Canadian members must indicate clearly that the matter is not a new question, but has been drilled in during past years by experience of governmental action, and indicates a well-grounded body of opinion indorsing the action of the council.

"The American engineer in question is a member of our society, and a valued one, and your query as to how we can protest his appointment on government work can be covered quite simply. A large number of Canadians are members of American societies and yet require a special act of Congress for each case to permit of their doing government work. May it be pertinent to inquire what would be the attitude of the American societies toward any American government which preferred Canadians, and passed over without consideration their own countrymen, or undertook to remove the legal restrictions imposed on alien engineers in the United States?

"The foregoing question does appear pertinent to such confirmed free traders as ourselves, as should we later obtain such protection as exists for engineers in your country we might be able to swap advan-

tages and both return to that high ethical plane which we may be forced reluctantly to abandon in the not distant future, as our campaign for the recognition of the engineer develops."

The Government Viewpoint

The comments of the *Toronto Mail and Empire* on the controversy are in part as follows:

"The government memorandum says: 'It is the policy of the government to employ Canadians for all public purposes; but having regard to the magnitude and seriousness of the questions which confront the government with regard to the railways, they have not been disposed to dictate to the commissioners in the selection of the best available assistance on this continent or elsewhere.' Indeed, the government could not expect the commissioners to undertake the very important and arduous task which has been set before them, unless they were given a free hand in such matters."

"Sir Robert Borden secured from Sir Henry Drayton a report upon the matter. Sir Henry states that no apology is to be made for the appointment complained of, that of Professor Swain of Harvard, himself a member, as Sir Henry points out, of the Canadian society. Sir Henry's letter incidentally throws much light on the character of the work which the commissioners have undertaken. He states his personal preference for local men, but adds that in a situation of the present magnitude the best men available must be got, wherever they may be. Professor Swain has not been selected to advise the commission on construction or operation.

FEW CANADIANS ELIGIBLE

"The commissioners have decided to obtain a physical valuation of the various railways, a work which calls for a large staff and six months of time. No general valuation has ever been made in Canada. It is work which Professor Swain has done in the United States for years. Sir Henry points out that all Canadian railway engineers of standing have been, at some time, or are now employed by railway companies, and the council of the protesting society includes two Canadian Pacific engineers, two Grand Trunk and two Canadian Northern, as well as engineers of the government railways.

"Besides the matter of public interest in having an entirely unprejudiced report,' Sir Henry says, 'the interests of the companies themselves must be considered.'

"He alludes to the unfairness of having the engineers of one road value the property of another. Sir Henry expresses the belief that the protest of the society was launched in good faith, but he calls attention to the council's circular calling upon members of the society to write to members of Parliament.

"It would be difficult,' says the commissioner, 'to imagine a more complete initiation of an attempt to achieve a result by political influence.' He gives the opinion that on permanent government work only Canadians should be employed, but says that for temporary work the best man should be got without regard to his parish or country, 'and a great hurt will be done to public ownership and administration in Canada if campaigns such as that now undertaken are to flourish in the future.'"

New Terminal Is Under Way at San Antonio

Program of Missouri, Kansas & Texas Includes New Passenger and Freight Stations and 7-Mile Subsidiary Belt Line

By D. A. TOMLINSON

Company A, Illinois Engineers, Camp Lyon, San Antonio, Texas

THE CONGESTION of present facilities at San Antonio, Tex., caused by increase in traffic, has led the Missouri, Kansas & Texas Railway to make designs for new and more adequate terminals for both passengers and freight. At present this road uses the Southern Pacific terminals, leasing certain freight facilities and running rights. The San Antonio Belt & Terminal Railway Company, controlled by the Missouri, Kansas & Texas, has been organized to construct and operate the desired terminal facilities, which for the present will be used exclusively by the latter. Final plans are now being prepared and preliminary construction is under way. It is estimated that the work now planned will cost \$2,000,000.

BELT LINE

The Missouri, Kansas & Texas tracks, entering from the north, now join those of the Galveston, Harrisburg & San Antonio (Southern Pacific) at June Avenue in the northeast part of the city, all trains of the former running in from there over tracks of the latter to the station at Commerce and Walnut streets. The new belt line will run due south from the Southern Pacific junction, as a continuation of the present Missouri, Kansas & Texas tracks for 2 miles, thence turn and run 4 miles west and then run northeast 1 mile to the new terminal in the block bounded by South Flores, Durango, South Laredo and Arsenal streets, half a mile southwest of the business center of the city. Thus to reach the new terminal from the present Missouri, Kansas & Texas tracks the new line will make a semicircle in the outskirts of the city on the east and south sides. The main line will be single track, with provision for a second track when desired, and increasing to two and three tracks near the terminal.

Present plans call for 7 miles of main tracks and 8 miles of yard tracks. A freight yard is to be constructed half a mile north of the present Southern Pacific junction on 200 acres of ground near Fort Sam Houston and Camp Lyon (formerly Camp Wilson), where the Illinois and Wisconsin militia is in camp.

NEW TERMINALS

The passenger station at Durango and South Flores Streets will be a one-story structure of mission design, costing about \$125,000. There are to be three station tracks, 1200 ft. in length, with provision for additional tracks when needed.

Just west of the passenger station will be a team yard consisting of thirteen tracks, placed in pairs on 12-ft. centers, with 35-ft. centers across the driveways. Beyond them, fronting on South Laredo Street, will be a one-story reinforced-concrete freight house, 50 x 255 ft., with four house tracks. At the north end will be a second story, 50 x 50 ft., for offices.

As far as practicable, street grade-crossings are to be avoided, the tracks passing under nine streets and over seven, and crossing but two at grade. There will be

four railroad grade-crossings—two with the Southern Pacific and two with the San Antonio & Aransas Pass. Nearly 500,000 cu. yd. of earth is to be moved, the average haul being about a mile.

This summer work was begun on the station and approaches, but as yet construction has not been started on the main line.

San Pedro Creek flows along the station site and approaches for some 2800 ft., and to secure space and prevent washouts after heavy storms a conduit to carry it through the property is under construction. South of the station it is of mass concrete, 14 ft. 4 in. wide and 6 ft. deep, and is open. It is on the west side of the right-of-way, leaving space for four tracks on the east side. This section, which will be 1400 ft. long, is nearly completed. The creek will be carried beneath the station in a covered conduit, also 1400 ft. long, consisting of two chambers, each 8 ft. wide and 6 ft.



NEW TERMINAL WILL BE NEAREST TO CITY HALL

deep, work on which will be started shortly. The open section of the conduit is of mass concrete; in the covered section the walls and bottom will be mass, and the top over which tracks will be laid will be reinforced. The construction of this conduit requires the removal of about 17,000 cu. yd. of earth.

DESIGN OF THE CONDUIT

In the design of the conduit the drainage area was found to be 1450 acres, and the average slope of the watershed 10 in 1000. Assuming a rain of 3 in., and computing the maximum runoff from the Berkli-Ziegler formula $Q = CrA\sqrt{s/A}$, with C , the percentage of runoff, taken as 75, Q was found to be 990 sec.-ft.

In the covered conduit, with each half 8 ft. wide and 6 ft. deep, it was considered allowable for the water to reach a depth of 5 ft. 9 in., and in the Kutter formula the coefficient of friction was taken as 0.012. Using the formula $v = c\sqrt{rs}$, s was 0.00284, r was 2.36, c was 147 and v was found to be 11.9 ft. per second. With an area of 5 ft. 9 in. by 8 ft. in each half of the conduit, the total runoff at this velocity would be 1094 sec.-ft. In the open conduit, giving it the same depth and allowable depth of flow, and a width of 14 ft., s being the same as in the closed conduit, and r being 3.16, v figured 14.2 ft. per second and Q 1143 sec.-ft.

As soon as certain franchise rights are secured from the city, work will be pushed on all sections on the line, and it is expected that it will be completed some time in 1917. The work is being done by Thomas & Jones, of St. Louis, general contractors, on the cost-plus-percentage basis. L. F. Lonnbladh is chief engineer of the belt line and of the Missouri, Kansas & Texas. E. L. Martin is resident engineer in direct charge of the work.

A Law Formulated to Prevent Public Service Strikes

Henry R. Towne Proposes Enlistment Contract Between Company and Employee and Orderly Treatment of Differences

AN enlistment contract for a stated term, after a probationary period for new employees, is one of the features of a law proposed by Henry R. Towne, past president of the Merchants' Association of New York, to insure continuous and adequate service from all public utilities. Such a contract would be required between each utility and each of its employees, and would be renewable by mutual agreement. The company could terminate the contract because of misconduct by the employees, as defined by law; because of slack business, in which case the employee should have thirty days' notice, or two weeks' pay and immediate release, or because of disability or superannuation, on stated notice. The employee could terminate the contract because of valid family or personal necessity, because of sickness or unfavorable effect on health, or for cause not stated, upon fair notice, without penalty if with the company's consent, otherwise subject to fine as provided by law.

SCHEDULES OF FINES

A schedule of fines for both corporation and employee would be a part of the plan. Fines against the company would be collectible from a fund created by the company and vested in a trustee; those against an employee from a fund created by the company's retention of a percentage of the employee's first wages—the company to return this fund with interest when the employee leaves the company. Several methods are proposed for the assessment of fines, which would be payable to the other party to the contract.

Employees would have a right to join any lawful organization, and could alone or in combination with others request concessions in wages or conditions of service, and the company would be required to give prompt and fair consideration to all such requests, without discriminating against any employee for participation in such requests. The employee could appeal decisions to a joint board of award, constituted under the law by joint action of the company and its employees, and both the company and its employees would have the right to appeal to an appropriate federal or state body.

During the term of any contract between the company and an employee the discharge of an employee or the cessation of services by the employee, except as provided by law and previously stated, would be an offense at law and punishable as such.

Typhoid Decreases in St. Louis

Filtration of the St. Louis water supply is probably responsible for the low death rate of 7 per 100,000 population reported in the latest annual report of E. E. Wall, water commissioner. He states that the quality of the water delivered to consumers for 1915 has always been of a higher standard than that set by the U. S. Treasury Department for drinking water to be supplied by common carriers. The death rate for sixteen years, beginning with 1900, is as follows: 29.2, 33.8, 37.1, 47.1, 36.2, 19.0, 17.4, 15.6, 14.2, 14.9, 13.8, 15.4, 10.4, 16.9, 12.4 and 7.0.

Every Possible Precaution Observed to Make Watertight Keechelus Reservoir, Washington

Impervious Foundation, Watertight Connection to Embankment and Inclosed Stilling Pond Features of Design of Dam in Yakima Valley

By C. E. CROWNOVER

Construction Engineer, U. S. Reclamation Service, Meadow Creek, Washington

IN the central part of the State of Washington tributary to the Yakima River is a large section of arid land extending for more than 100 miles along the river. Irrigation had been practised in this valley since 1867, but confined to small areas along the small streams where diversion was not difficult. With the advent of the Northern Pacific Railway in 1886, real irrigation development began. From that time until the passage of the Reclamation Act, in 1902, irrigation developed in the Yakima Valley until 121,000 acres were under cultivation in this manner. The natural flow of the Yakima River and its tributaries had, during the latter part of the irrigating season, been overappropriated, and was leading to serious complications of water rights.

No storage had, up to this time, been provided, and it was evident that before further development could take place it would be necessary to supply storage water. With this in view, investigations were begun by the U. S. Reclamation Service in 1904. Preliminary surveys indicated that at the headwaters of the streams favorable sites for storage reservoirs existed, and that these were capable of economical development. The Secretary of the Interior required that before any work be undertaken in the valley, either for the impounding of storage or the placing of water on the land, all water rights be settled and all pending litigation dismissed. This was accomplished late in 1905, and early in 1906 construction was authorized.

The work was made possible by an act of the State Legislature of March 4, 1905, granting special privileges to the United States. In conformity with this act a notice was filed in the office of the State land commissioner on May 10, 1905, withdrawing all the water of the Yakima River and its tributaries then unappropriated. This withdrawal has been maintained by the extension of time on the part of the State for

the construction of the necessary works for the use of the waters.

WATER TO IRRIGATE MORE THAN 450,000 ACRES

Extended investigations were at once begun to determine the areas that could be most economically watered and the maximum amount of storage capacity that could be developed. It was found that the amount of land susceptible of irrigation, and on which it was possible to place water at a

construction of canal and distribution systems was begun in the valley below by the Reclamation Service, and the completion of these has kept pace with the development of storage.

KEECHELUS LAKE STORES 152,000 ACRE-FEET

By the construction of a dam at the foot of Lake Keechelus a reservoir will be created with a storage capacity of 152,000 acre-feet. Of that amount 40,000 acre-feet is obtained from substorage by lowering the natural surface of the lake 30 ft. and the remainder of 112,000 acre-feet by raising the lake surface 57 ft.

The material at the site of the dam is a glacial deposit heavily covered with forest trees. The length of the embankment is 6500 ft. at the crest. In order to utilize several natural dikes, seven curves are introduced into the alignment, as shown on the general plan. The height of the em-

DATA ON YAKIMA RIVER RESERVOIRS

Reservoir	Capacity, Acre-Feet	Length of Dam, Ft.	Maximum Height of Dam Above Gate Sill, Ft.	Contents of Embankment, Cu. Yd.	Type of Dam
Bumping Lake	34,000	3,500	40	233,800	Earth and gravel
Kachess Lake	210,000	1,400	75	182,100	Earth and gravel
Keechelus Lake	152,000	6,500	100	522,000	Earth and gravel
Clealum Lake	501,000	700	188	415,000	Earth and gravel
Tieton	185,000	1,030	192	991,000	Earth and rock fill
	1,082,000				

reasonable cost, exceeded that for which water could be made available. It was discovered that storage reservoirs with a combined capacity of 1,082,000 acre-feet could be constructed at a reasonable cost, and that the water so stored, when properly handled in conjunction with the flood flows, would be sufficient for the irrigation of 452,000 acres in addition to the areas which have sufficient low-water rights.

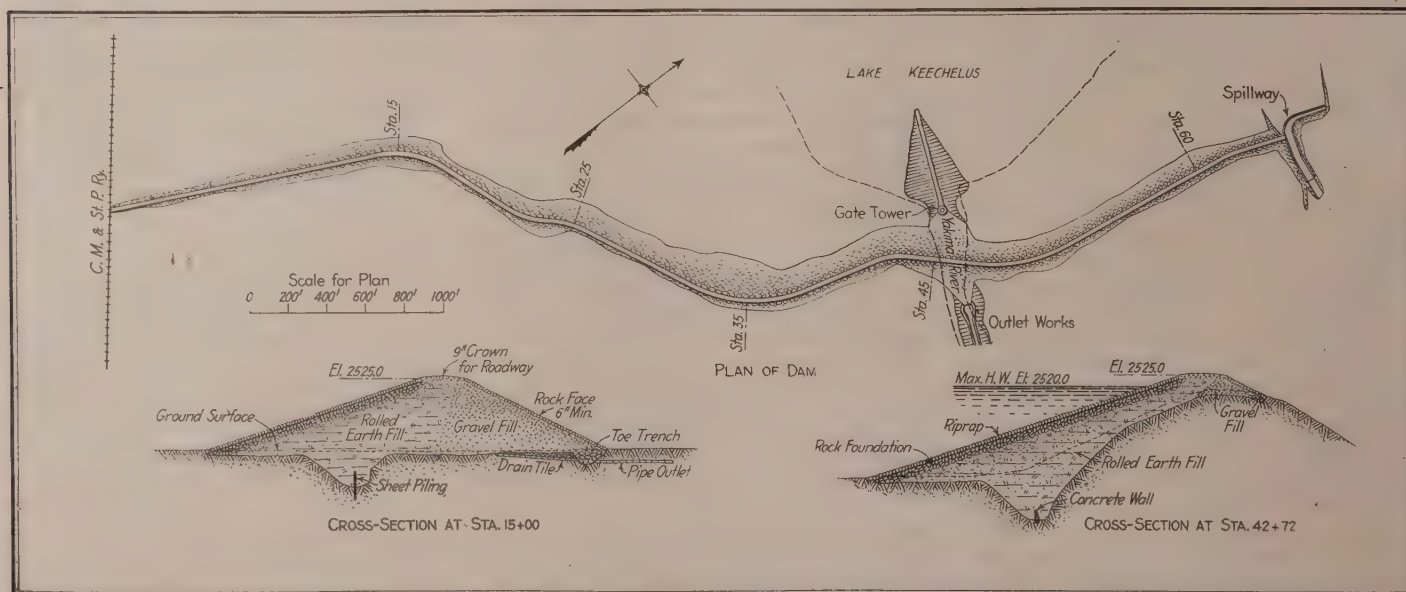
These five reservoirs are all located near the headwaters of the Yakima River or its tributaries. In no case does bedrock exist within a reasonable depth, so that the earth or rock-fill type of dam has, in all cases, been adopted. The accompanying table gives the principal data regarding the various reservoirs.

Construction was begun in the order named, the first being completed in 1910, the second in 1912 (Engineering Record, Vol. 65, page 101), and the third, at Lake Keechelus, is now under construction. The

bankment above the original river bed at the river section is 70 ft., and above the gate sill at this point 100 ft. The top width at the crest is 20 ft., the water slope 3:1, while on the lower side the slope is 2:1. A cutoff trench 10 ft. wide at the bottom has $\frac{3}{4}$:1 side slopes, and varies in depth from 5 to 20 ft. At the river section it was found more economical to place the core wall in a deep, narrow trench. The position of the core wall with reference to the cross-section of the dam is shown in the sections, while its depth and height are shown on the profile.

FEATURES OF DESIGN

In the design and construction of this dam the following important points of earth-dam construction have been kept constantly in mind: To secure an impervious foundation and embankment and a watertight connection between the foundation and embankment. It is recognized, however,



UTILIZING NATURAL DIKES AS PART OF DAM CAUSED CURVED ALIGNMENT; CROSS-SECTIONS GIVE DETAILS OF EMBANKMENT

that only under the most favorable conditions can a high earth dam be constructed that will be absolutely watertight. Therefore, the aim here has been to discourage, as far as possible, the entrance of water either into the embankment or under it. Should seepage reach the lower side of the core wall, provision has been made to prevent saturation of either embankment or foundation and to drain away any water that may not have been intercepted. Particular care has been taken to prevent seepage along the wall of the conduit. The spillway is in excavation, and well removed from the body of the dam.

Details of the construction methods employed on this project will appear in a future issue. In that article the methods employed to make the reservoir as nearly 100 per cent watertight as possible will be discussed.

The original designs contemplated driving an outlet tunnel 3300 ft. long, connect-

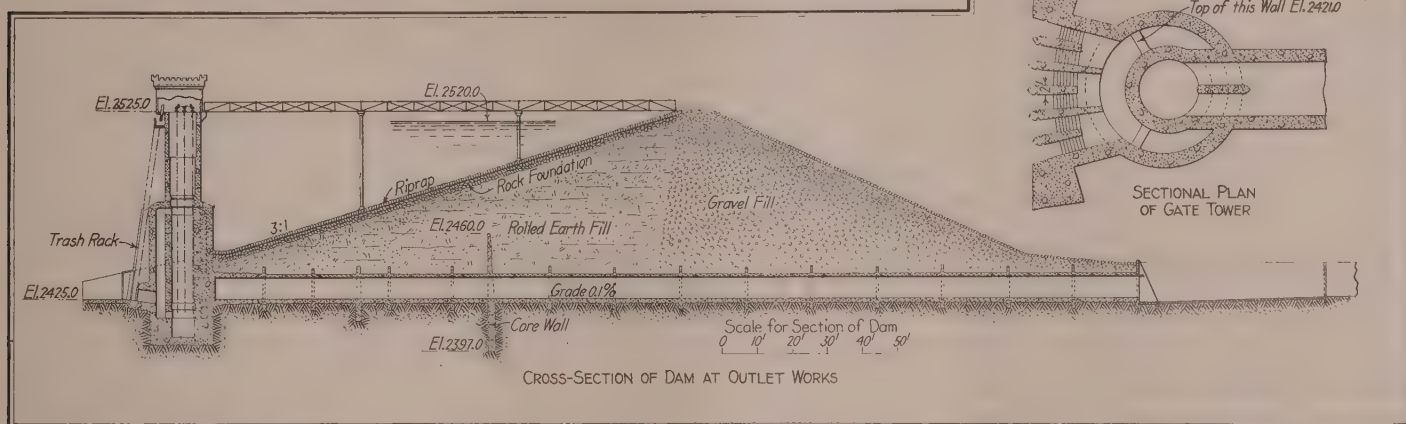
the energy is destroyed in the tower itself before entering the conduit.

The design consists essentially of a double reinforced-concrete tower connected by radial walls. The outer tower connects at the front with the reservoir water, while the inner tower connects at the rear with the outlet conduit. The water, after entering, flows freely in the annular space between the two towers. The tendency to form eddy currents is counteracted by the radial walls, which are not continuous but in 4-ft. vertical sections. The water's entrance to the inner tower, and thence to the outlet conduit, is controlled by two cast-iron gates with smooth open interiors, each 12 ft. in diameter and 4 ft. in height, placed on the inside of the inner tower. One is half way up the tower for high heads and the other depressed below the outlet tunnel for low heads.

Each gate covers nine rectangular gate

pressure is practically equal at all points on the circumference of the cylinder gates, there will be little, if any, friction. Therefore, a simple hand-operated raising and lowering device is planned.

The horseshoe type of outlet conduit, rather than the circular type, was adopted because at the end of the irrigation season it may be desirable to discharge relatively large amounts of water when the supply in the reservoir is low. The walls of the conduit above the core wall are designed to withstand a pressure equivalent to hydrostatic head for full reservoir, while below the core wall fluid earth weighing 90 lb. per cubic foot for a depth of 15 ft. above the arch was assumed. The conduit passes through the core wall, both having been



GATE TOWER SO DESIGNED THAT SPOUTING VELOCITY IS DESTROYED BEFORE WATER REACHES CONDUIT

ing with the river below by a open cut. Near the upper, or lake, end a concrete gate tower was to be placed partly through a shaft containing the outlet-control gates. The grade of this tunnel was placed 20 ft. lower than the outlet grade as finally built, and afforded 24,000 acre-feet more storage than now obtained. Construction was begun on this design and four headings were started through two shafts. After driving a total of about 200 ft. of top headings, such unstable ground—carrying a large amount of water under pressure—was encountered that further progress, except at heavy cost, was impossible. As it was not believed that the additional storage to be gained justified the expense, the scheme was abandoned and the grade of the outlet tunnel raised 24 ft. and placed in the river section.

The location shown on the plan consists of three principal features—intake channel 565 ft. long, conduit 495 ft. long, and open channel section (not shown) below the dam 3300 ft. long. The total length is 4380 ft. The total excavation was 314,000 cu. yd., and maximum cut 60 ft. A 12 x 12-ft. horseshoe-type reinforced-concrete conduit under the dam connects with a circular gate tower at the upper toe, in which are located the gates for controlling the outflow.

METHOD OF KILLING SPOUTING VELOCITY

Ordinary forms of gate control, involving slide gates discharging directly into the outlet tunnel, would, in this case, under a full reservoir head, produce spouting velocities exceeding 70 ft. per second. Such a condition is unsafe for earth-dam construction. A circular type of tower was adopted, as shown, with cylinder gates so placed that

openings through the wall of the inner tower. Each of the two gate openings is formed by cast-iron top and bottom plates. The nine piers forming each opening are of hollow cast-iron, with holes in top and bottom corresponding to similar ones in the top and bottom plates. The piers are filled with concrete, and the concrete wall of the tower thus becomes continuous. The gates are guided in their travel by a circular cast-iron extension anchored to the concrete wall containing nine guide strips arranged so as to prevent rotation. The walls of the sump are lined with heavy boiler plate, while the bottom has 12-in. timber lining. Both are removable.

All water enters the space between the two towers through six 3 x 7-ft. rectangular openings. These openings are controlled by slide gates operated by hydraulic cylinders at the top of the tower. They are for emergency use and in their normal position are all open. They are closed only for inspection of the structures or in case of accident. These openings are protected by trash racks.

Water passing through the upper cylinder gate drops through free space upon a water cushion not less than 20 ft. deep before passing out through the conduit. When the lower cylinder gate is in use the water, after passing through, rises in the tower. Dangerous spouting velocities are eliminated, the head over the conduit entrance being reduced to that sufficient to produce only the initial velocity, which for maximum flood flow of 2000 cu. ft. per second is but 16 ft. per second. Each gate will be operated by three rising stems from the gate house on top of the tower. As the

formed at the same time. Above the core wall, collars 18 in. thick, and extending out from the conduit 4 and 5 ft. alternately for its entire circumference, were placed at intervals of 25 ft. Similar collars surround the conduit between the core wall and its lower end at intervals of 35 ft.

To slow up the water as it emerges from the conduit, so that it will not erode the channel below, a stilling pool will be constructed as shown. Previous experience on this project has proved that under even moderate heads, where spouting velocities are produced, it is necessary to provide concrete-lined channels for at least 500 ft. from the lower toe of the dam. Even then considerable trouble is experienced in maintaining the channel below this point. The design of tower here described, by eliminating the high conduit velocities, gets rid of this very troublesome factor in the maintenance of earth dams.

DETAILS OF SPILLWAY

The spillway, located in a solid rock cut at the north end of the dam, consists of a concrete weir of the ogee type, 300 ft. long, and discharging through a concrete-lined channel into a natural ravine. This in turn empties into the Yakima River about a mile below the dam. The spillway crest is 10 ft. below the top of the dam, and, with a discharge of 10,000 sec.-ft., the water surface is 4.5 ft. deep over the crest. The greatest flood of record was 6200 cu. ft. per second. The curved channel was adopted rather than a straight one because it was impossible to place the entire structure in solid rock at a minimum cost. While the entire channel is located in solid rock, it

proved more economical to line throughout with concrete on account of the increased capacity and consequent reduction of excavation.

The work is under the general direction of the U. S. Reclamation Service, of which A. P. Davis is director and chief engineer. Until July, 1915, the work was under the

administrative supervision of G. H. Swigart, supervising engineer of the Washington division. Later, S. B. Williamson, chief of construction, had supervision. The writer is in direct charge of construction on the Yakima storage project, assisted by R. E. Post, superintendent of construction, and J. R. Sherman, assistant engineer.

Winnipeg Aqueduct Cracks Can Be Repaired Within Original Cost Estimate

Consulting Engineers Suggest Wider Base and Reinforced Invert to Prevent Settlement of Concrete Conduit in Bad Ground

IN spite of cracks in the concrete invert and arch of the Winnipeg aqueduct, which developed in certain sections last year as the result of settlement of the invert under the side walls in treacherous ground, the 97-mile conduit which will carry water from Shoal Lake to the towns comprising the Greater Winnipeg Water District will be completed within the original estimate of cost, and, with repairs now in course of completion, will fulfill the purpose for which it was intended. This is the substance of a report by a board of consulting engineers consisting of Brig.-Gen. H. N. Ruttan, ex-city engineer of Winnipeg; J. G. Sullivan, chief engineer, Western Lines, Canadian Pacific Railway, and R. S. Lea, consulting engineer, of Montreal, submitted Sept. 26 to the administration board of the Greater Winnipeg Water District. Pending the results of tests which may modify present plans, the engineers indorse the following precautions, taken during this year's working season, against settlement of future construction: In foundations of boulder clay, hardpan and gravel, extend the unreinforced aqueduct base 8 in. on each side; in more compressible soils, retain the 8-in. extensions and reinforce the invert.

Between the reinforced invert, distributing the load over the entire width of the base of the aqueduct, and the plain invert with 8-in. extensions there is, the consulting engineers find, a wide difference in the pressure imposed upon the foundations. There are evidently intermediate designs, according to the report, which may be safely and advantageously employed. Experiments now under way will indicate what modification in the designs may be desirable. As for the cracked sections of aqueduct, these are being repaired by cutting grooves along the cracks and filling them with neat cement. The report points out that the damaged sections have shown no settlement since last April, and it is believed that they have reached a permanent bearing. Hydrostatic tests also have developed a satisfactory degree of watertightness in the repaired sections of the work.

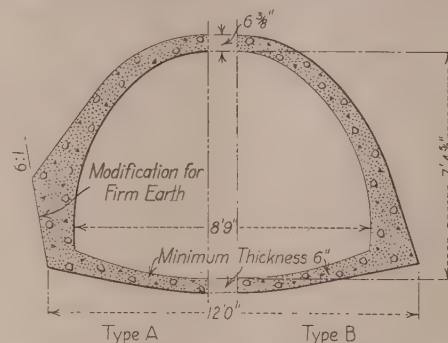
Defects in the aqueduct constructed during the 1915 season were first discussed in a report submitted last February by James H. Fuertes, consulting engineer of the Winnipeg aqueduct, and W. G. Chace, chief engineer. To secure an independent expression of opinion on the subject matter of this document the administration board of the aqueduct appointed the special board of three consulting engineers, Messrs. Ruttan, Sullivan and Lea, previously referred to. A summary of their findings, which have just been made public, is given below.

The total length of the aqueduct is 96.6

miles, most of it being of the cut-and-cover, flow-line type, with a horseshoe-shaped plain concrete section varying from 5 ft. 4 $\frac{3}{4}$ in. high and 6 ft. 4 $\frac{3}{4}$ in. wide to 9 ft. high and 10 ft. 9 in. wide. The depth of earth cover over the top of the arch is 4 ft. The concrete is proportioned 1:3:4.

EXTENT OF CRACKING

The construction of the aqueduct was carried on at ten different points during 1915, and altogether more than 65,000 ft. were completed. In about 14,000 ft. of this total length invert cracks developed, usually a single crack along the middle of the invert, but in a few cases, in badly cracked sections, damage appeared at the side walls of the arch as well. Close observation has been kept of these cracks from their first



TYPICAL AQUEDUCT SECTIONS SHOWING, AT LEFT, MODIFIED FORM FOR FIRM EARTH

appearance. The last movement was observed at the beginning of April, since which time there has been no indication that any further settlement has taken place.

In 4815 ft. the cracks vary in width from 1/16 to 1/4 in., and in a few cases slightly larger. A total of 4017 ft. has cracks from 1/64 to 1/16 in. wide. In the remaining 5193 ft. the cracks are merely hair cracks, which can be discovered only by very careful examination. In many arches where the invert cracks are of considerable size corresponding cracks have occurred along the crown.

SETTLEMENT CAUSED CRACKS

The cracks which formed at Mile 23 are much more extensive and much larger than in other portions of the work, and are practically continuous. Mile 23 is in the "prairie section," where the material is clay. The type of invert referred to as "standard invert for firm soil" was used. The bearing power of the foundation material, according to the report, proved to be much less than was anticipated, and, as a consequence, the considerable settlement under the load, as distributed by the type of invert used, has resulted in the cracking of

the invert and then of the arch. In fact, the report attributes practically all of the cracking throughout the work to this same general cause.

At Mile 43 all of the larger cracks occurred in the shallower cuts. Here the subsoil is referred to as "moist sand with tendency to springs." All of the invert cracks, and most of the arch cracks, according to the report, were caused, as in the case previously referred to, by settlement under the side walls, much of which—and probably the greater part—was apparently due to insufficient protection of the trench bottom before the inverts were put in place.

It appears from the report that the backfilling of the arch on the 1915 work was postponed until the end of the season. "If the backfilling had closely followed the arch construction," the consulting engineers state, "the appearance of cracks due to settlement would have suggested and permitted the prompt adoption of measures which would have prevented most of those which have occurred."

METHODS OF REPAIR

The cost of the portion of the entire aqueduct structure in which settlement cracks have occurred is \$104,360. The cost of the invert alone is \$34,198. The damaged work, it is said, can be repaired to be as permanent and efficient as other portions of the aqueduct. Hydrostatic and other tests made during the present season on portions of the completed aqueduct lead to the belief that none of the work so far built will have to be removed.

The method of repairing the cracked aqueduct sections is as follows: The section to be repaired is thoroughly cleaned. The cracks are cut out to a depth of 1 $\frac{1}{2}$ to 2 in., and to a width of about 1 in. This groove, as far as possible, is made wider at the bottom than at the top, and never V-shaped. It is carefully cleaned with water and then packed with neat cement, slightly moistened and hammered solidly into place, using a special caulking tool. This makes not only an exceedingly tight joint but a very strong one. Several sections of invert, including portions of these joints, have been cut and tested. The cement filling, even after having been in place only two or three days, was found to adhere so strongly to the concrete that when broken the break has generally been in the old concrete, sometimes in the filling, but never at the junction of the two.

LEAKAGE TESTS SATISFACTORY

Two sections of aqueduct at Mile 23, each about 270 ft. long, and purposely selected to include the most seriously damaged portion of the 1915 work, were repaired in this way in July. Watertight bulkheads were built at each end of the sections, which were then filled with water to the level corresponding to the rated discharge of 85,000,000 gal. per day. Daily records were kept of the loss of water as indicated by the fall in level. The results thus far, according to the report, are very satisfactory. The total loss at the present time is only about 250 gal. per day from each section, each of which has between 200 and 300 lin. ft. of expansion joint below water level. This leakage, it is pointed out, is equivalent to that which would escape through a single hole the size of a match. "The result shows," the report states, "that the cracks have been thoroughly closed. The loss of water stated is equivalent to less

than 5000 gal. per mile of aqueduct, which is much less than the limit usually specified for large concrete pipes under low heads."

Evidence furnished by a series of tests of portions of the completed aqueduct provided with special facilities for accurate observations of settlements, taken in connection with the fact that no settlement has taken place in the cracked sections since early in April, gives some indication that in most, if not all, of these sections the aqueduct has come to a permanent bearing. There is plenty of time to obtain assurance of this, and until another year's experience is available it would probably be advisable, the consulting engineers believe, to restrict repair work to what may be required to secure such further information as may be considered necessary in the meantime.

COST OF REPAIRS

The entire cost of repairs described in the foregoing, including labor, materials and incidentals, amounts to about 93 cents per lineal foot of aqueduct. As the sections repaired are of large size, and were cracked more seriously and extensively than any other parts of the 1915 work, the average cost per foot of such repairs will no doubt be much less, so that even if much of it should have to be done over the total cost of repairing will probably not be very great.

In an interim report, submitted May 5, the board of consulting engineers indorsed certain tentative measures to insure the integrity of future work. These involved an extension of the aqueduct base 8 in. on either side, and, where conditions demanded,

the use of a reinforced instead of a plain concrete invert. The recommendation for the 8-in. extensions on each side of the aqueduct was made, according to the later (Sept. 26) report, notwithstanding the fact that nearly 10 miles of the 1915 work, with similar inverts, but without extensions, had stood without cracks or other indications of undue settlement. The 8-in. invert extensions were used in the hardest foundations on all of the 1916 work to date. The report states that they are probably being now employed in many places where they are unnecessary, and in the future the extent to which they may be used should be decided by the engineers of the aqueduct.

The reinforced invert design was used in compressible soils throughout the 1916 work, except where the character of the foundation, in the judgment of the engineers, justified the use of the plain extended invert. About 15 miles of aqueduct was constructed during the present season in accordance with these recommendations, and the greater part of it has been back-filled. So far, no settlement cracks have developed in any of this work. The reinforced invert in use, it is pointed out, is designed to distribute the load over the entire width of the base of the aqueduct. This reduces the unit pressure to such a small amount that the 8-in. extensions are said to be unnecessary, and can be safely omitted. Between the reinforced invert, distributing the load over the entire width of the base, and the plain invert with 8-in. extensions there is, according to the report, a wide difference in pressure imposed upon the foundations. There are evidently intermediate designs which may be safely and advantageously employed. Tests to deter-

mine what these designs are are now being carried on.

COST OF MODIFIED DESIGNS

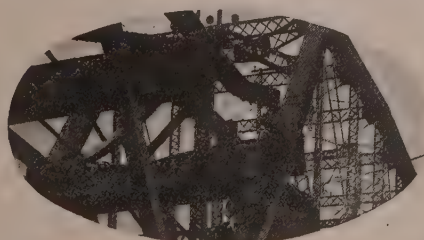
Cost estimates indicate that if construction were to be continued as at present, without any changes in the modified designs followed during 1916, except the omission of extensions to the reinforced inverts, the total increased cost of the project would be in the vicinity of \$500,000. If it is found that intermediate forms of reinforced invert, less heavily reinforced, may be safely used in portions of the work, this amount will be materially reduced.

The original estimate of cost of the aqueduct from Deacon to the intake, including the cost of cement, and based on the contract quantities of the different items, amounted to \$7,097,640. In these quantities a liberal allowance was made to cover contingencies, uncertainties as to foundations, etc. A revised estimate, based on the accurate information made available since the work was actually placed under construction, and including the cost of continuing the present expensive methods of constructing the inverts, amounts to only \$6,867,700. According to these estimates the aqueduct will be completed, under the modified designs, well within the original estimate.

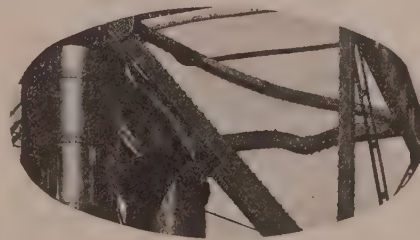
The board of consulting engineers concludes its report with statements to the effect that the aqueduct, when completed, will satisfactorily perform the service for which it was designed; that the work will be of such substantial and permanent character as to require only a reasonable charge for maintenance; and that the cost of the project will be fair and reasonable.



Heat From Burning Timber Floor Warps Steel of Bridge Over Missouri River at St. Charles, Mo.



THESE pictures of damage to the steel work of the St. Charles (Mo.) bridge caused by the burning of the timber floor, described in last week's issue, tell the story better than words. The upper photograph was taken from a point southeast of the structure. That to the left shows the buckling of several members of the deck truss span which caused the damage to the concrete pier in lower right view. Buckled floorbeams and laterals of this span, seen from beneath, are shown in the lower left cut. The lower center view indicates the bent sub-struts in the east through span. Right center shows the west end of the deck truss span.



Literature

For the Civil Engineer and Contractor

New Publications

DEPENDABLE CONCRETE—HYDRATED LIME and Its Effect on Workability, Segregation, Uniformity, Strength and Permeability. Paper, 6 x 9 in.; 14 pages; illustrated. Pittsburgh, Hydrated Lime Bureau of the National Lime Manufacturers' Association.

SOUTH AMERICA—STUDY SUGGESTIONS. By Harry Erwin Bard, A.M., Ph.D., secretary of the Pan-American Society of the United States. Cloth, 5 x 7 1/2 in.; 68 pages; illustrated. Boston, D. C. Heath & Company.

METHODS OF MAKING ELECTROLYSIS SURVEYS. By Burton McCullom and G. H. Ahlborn. Technologic Paper 28, U. S. Bureau of Standards. Paper, 7 x 10; 84 pages; illustrated. Washington, Government Printing Office.

CONCRETING IN COLD WEATHER. Paper, 6 x 9 in.; 15 pages; illustrated. Chicago, Portland Cement Association.

A GRAPHICAL METHOD FOR THE CORRECTION OF STEEL TAPES. By Walter Scott Weeks. Paper, 7 x 10 1/2 in.; 8 pages; illustrated by chart. Berkeley, Cal., Publication in Engineering No. 9, University of California. 10 cents.

REPORT OF THE STATE ENGINEER AND SURVEYOR, New York, 1915. Vol. 2, on Hydraulic Data. Cloth, 6 x 9 in.; 428 pages; illustrated. Albany, J. B. Lyon Company.

CENTRIFUGAL PUMPS AND SUCTION DREDGES. By E. W. Sargeant. Cloth, 6 x 9 in.; 188 pages; illustrated. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd.

A TEXT BOOK OF PRACTICAL HYDRAULICS. For the use of mining schools, technical colleges, county and hydraulic engineers. By James Park, dean of the faculty of mining engineering at Otago University, New Zealand. Cloth 5 1/2 x 7 3/4 in.; 284 pages; illustrated. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd. \$4 net.

Books Reviewed

The Stability of Arches

Author, Ernest H. Sprague. Vol. 20, Broadway Series of Engineering Handbooks. Cloth, 4 1/2 x 7 1/2 in.; 141 pages; illustrated. London, Scott, Greenwood & Son; New York, D. Van Nostrand Company. \$1.25 net.

This little volume is one of a series of engineering handbooks issued in London, and is designed to give satisfactory methods in investigation of masonry arches, based upon the elastic theory of deformation. For its size it is unusually complete in treatment, covering in more or less elementary fashion the principles and practical formulas used in the design of three-hinged, two-hinged and hingeless arches. Much of the treatment in the latter case follows Melan's analysis, and credit is also given to Tolkmitt.

A short historical sketch of the development of the arch forms an interesting introduction, Chapter 1, followed by a table of long arch spans, which, however, is not brought quite up to date for American bridges. The three-hinged, or three-pinned arch as it is designated in the text, is treated in Chapter 2, beginning with a general statement of methods of solving arches of any type. An example is given for uniform loading, using three methods of solution—(1) line of pressure, (2) calculation and (3) influence lines. A spandrel-braced arch is then solved, using the methods of composition of forces and influence lines.

In Chapter 3, after showing that the actual arch tests made in 1900 and the results of experiments on arch models using polarized light have dispelled early distrust of the elastic theory, the fundamental gen-

eral formulas are derived, including the values for thrust and change of temperature as well as bending. Approximate formulas by which allowance can be made for thrust and temperature are included.

In Chapter 4 the two-hinged arch is treated, the true pole distance for the pressure line being computed by ratio, using a trial diagram. An example (150-ft. arch) is fully solved by three methods. The parabolic arch is also considered, and influence lines are drawn for bending moment at a given section. Chapter 5, on the hingeless arch, includes the graphical method for dividing the arch ring to give constant ratio of length to moment of inertia of section, and contains a good analysis based upon such sections, applying the elastic theory. The use of tables and influence lines makes the solution as simple as possible. A short method by Mesnager is reproduced.

The last three chapters treat the generally accepted analysis for masonry arches by the middle-third limit (using the principle of least work and reduced load contours), the design proper (including empirical formulas and the form of the arch ring) and the loads and unit stresses (including formulas for live loading) and a complete analysis for stresses across the normal section, using the elastic theory of Melan. An appendix contains useful graphical methods for constructing circular and parabolic arcs.

Aside from the crowded figures and poor lettering of the illustrations, the book is well printed, especially the mathematical formulas. Those who desire the simpler treatment of arch problems should find it satisfactory and useful.

The Planning of the Modern City

Author, Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City. Cloth, 6 x 9 in.; 423 pages; 149 illustrations. New York, John Wiley & Sons, Inc. \$3.50 net.

The prime purpose of this book is to bring out the engineering side of city planning. As the author points out in his introduction, most previous works have featured the architectural or the administrative side. The author is modest in his justification of the book—so much so that when he states his illustrations, of which he favors plans and diagrams, are chosen rather to visualize a certain point than to adorn a book of travel, one might expect a prosaic technical work of the textbook type, useful but not entertaining. The reader does not go far, however, before he finds that this is no ordinary textbook. The pleasing style would keep the reader absorbed even if the real merit of the subject-matter were less. The thoroughness with which the author has handled a subject with which he is so evidently entirely at home would force the reader to give his attention if the style were less pleasing. Combining the thoroughness with the pleasing style, and adding these alleged utilitarian illustrations, which are drawn from all parts of the world, we have a book that should certainly be accessible for its technical value to all

who have to do with city planning, and that will not prove wholly unentertaining to engineers and others who are not especially interested in city planning.

The first three chapters are introductory. They go into the reasons for city planning and the history of the movement, and the third chapter shows how a large part of city planning is the correction of mistakes.

It is in the fourth chapter, "Elements of a City Plan," that the author gets at the heart of his subject. While other authorities that he cites have enumerated other elements, he, as in his paper presented at the International Engineering Congress in 1915, gives four elements—the transportation system, the street system, the park and recreation facilities and the location of public buildings.

This chapter and the four succeeding ones devoted to the four elements of the city plan, like some other parts of the book, are elaborations of the engineering congress paper, but those who have read that paper should not suppose they have learned all of the author's ideas on those subjects. The chapter on the street system, which contains 44 pages, is one of the best in the book. The author is emphatically in favor of a radial street system and opposed to an inflexible rectangular system that rides roughshod over topography and landmarks. By public buildings the author means not merely buildings publicly owned, but markets, hospitals, railroad stations and the like, and even bridges and monuments. The pages are replete with illustrations of the good and the bad.

A short chapter on the economical value of the city plan is followed by one on the industrial district. "Street Traffic" and "Street Details—Utility and Adornments," are next taken up. Chapter 13, "The Railroad in Its Relation to the Street System," is devoted mainly to grade-crossing elimination. The author goes to some extent into the grade-crossing laws of various states, but does not commit himself as to which laws he deems best. The chapter on restrictions gives those as to heights, arrangement and use of buildings in many American and European cities, and contains many useful suggestions for communities considering the placing of restrictions.

In a chapter on the environs of a city the author points out the mistake of stopping the city plan at the city line. He realizes the difficulty of getting co-operation between towns, but thinks metropolitan planning districts could do much for the highway systems as they do now for water supply, sewerage and parks.

Chapter 16 is on garden cities, and four of the five remaining chapters have to do with the financial and administrative side of the work, their titles being respectively "City Planning Legislation," "Progress and Methods," "Financing a City Plan" and "Municipal Land Policies." The author has presented part of the chapter on financing the plan before, but it is a very pithy discussion of the subject. The closing chapter is on the opportunities and responsibilities of the municipal engineer.

Possibly some phases of the subject of city planning have been more fully presented by others. There is no phase, however, that stands out in the reviewer's mind as inadequately treated. Surely the author is to be congratulated on having ably presented the engineering side of city planning, and the book deserves a wide circulation.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Grouting Alternate Holes Reduces Drilling Time

SIR: In your issue of Sept. 2, 1916, appears an article describing the construction of the dam in the Ripogenus Gorge of the West Branch of the Penobscot River, in Maine. Here it is stated that the dam is being built on traprock, "the joint cracks of which are being grouted to an elevation 50 ft. below the footings."

As grouting is being resorted to more and more as a means of closing the seams and cracks underlying large dams, and as the attempts have sometimes resulted in in-

of the hole as drilled. When the holes on this wide spacing have all been drilled, tested and grouted, the drill may be returned to the beginning point, and a row of secondary holes put down immediately between those already grouted. These, too, should be tested and grouted as soon as drilled. These secondary holes should show decreased loss of water on testing, and by continuing the process of putting down holes intermediate between those already in, tightness may be secured, though not in all materials. At least, that is the writer's experience.

As grouting is becoming more common, it

an equal footage of the primary holes. That is, the grouting, by stiffening up the material, had eliminated the caving of the holes (the dropping in of small particles of rock from the side of the hole) and had increased the speed nearly 100 per cent.

H. A. RANDS,
Rands & White, Civil and Hydraulic Engineers.
Portland, Ore.

Topping Trees with Dynamite

SIR: I notice in your issue of Sept. 23, page 392, a paragraph describing the cutting off of the tops of trees by dynamite. I used this method of "topping" trees some years ago in British Columbia, and it is certainly cheap and satisfactory. However, it is quite unnecessary to put a ring of cartridges around the tree. My method was to send a man up on a pair of lineman's climbers and let him bore 2-in. holes with a ship auger at right angles to one another, one about 1½ in. above the other. A stick of ⅞-in. dynamite was then placed in each hole, capped with regular electric-fuse caps, and connected by wire to an ordinary blasting machine or "pull-up battery." By this means the man can descend at leisure and explode the dynamite from a safe place behind a neighboring tree.

The effect produced is remarkable. A tree that is from 10 to 14 in. in diameter at the point where it is cut is taken off without splitting, or even brooming to any extent. It is far the cheapest and safest way that trees can be topped.

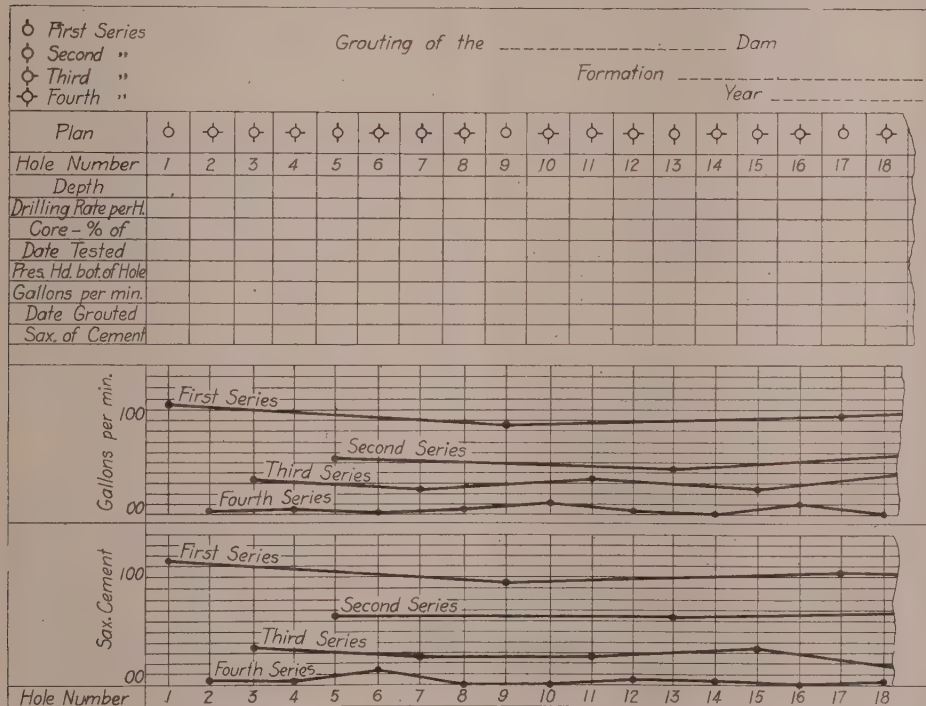
In passing, it may be a matter of interest to mention the object of the tree-topping described above. On account of the heavy snows and generally adverse conditions existing in the British Columbia woods in the winter, our construction work was set back, and it was difficult even to get supplies to the camp. On top of these troubles we were in urgent need of electric power at the camp for the running of air compressors and hoists, but it was practically impossible to construct a pole line until spring. In this emergency it occurred to the writer that by felling a little timber to clear the line, and selecting small hemlocks or firs to act as poles, these could be topped, crossarms bolted on and the wires strung with little difficulty. This was done very quickly, several miles of line were built and current was furnished the camp long before it would have been possible by other means.

GEORGE S. BINCKLEY,
Consulting Hydraulic Engineer.
Los Angeles.

Manufacturers Should Tell What Parts Wear Out First

SIR: Referring to Major Amos A. Fries' letter in the Engineering Record of Sept. 30, page 419, "Manufacturers Should Tell What Parts Wear Out First," brings out precisely what the writer has endeavored to get manufacturers to state when buying and ordering machinery. When ordering machinery that is to be set up and operated on the opposite side of the globe it is quite impossible for an engineer who orders the machinery or apparatus from makers' catalogs to form an idea what spares should be ordered at the same time, to keep the machinery in operation, say one year, as he usually cannot guess what parts are liable to break or wear out first.

Who can be expected to know better than



CLOSING OF SEAMS BY GROUTING ALTERNATE HOLES SHOWS AT GLANCE ON THIS RECORD

different success, it would be interesting to know more concerning this part of the work in connection with the Ripogenus Dam. Costs, too, would be of value to those having in hand similar problems in other places. Past experience indicates that grouting will be successful in firm rock having definite seams and cracks, but of less value in conglomerates and breccias. At least we may say that success is much easier of accomplishment under the former conditions than under the latter. Based on this experience, it would seem safe to predict success for the dam under consideration.

In order to know at all times what progress is being made it is best to do all testing from a tank located at any convenient point somewhat higher than the crest of the proposed dam. This tank should be provided with a gage, and the loss of water for each minute recorded. A good plan is to first drill, test, and grout a row of holes on rather wide spacing, say 12 ft. or over, clear across the bed of the stream, or as far as circumstance will permit, each hole being tested and grouted as soon as drilled. Sometimes it is well to make mid-depth tests

would be of benefit, in a measure, to standardize the methods of tabulating and presenting the results; and as a contribution to this end the writer would suggest the form here presented, which is substantially such as he has seen used on two different jobs.

There may be some question as to the value of giving the rate of drilling and the percentage of core in a report having as its principal object the setting forth of the progress of the grouting. This is explained by the fact that the grout, when forced into each hole as drilled, sometimes has a marked effect on the rate of drilling, and possibly, too, on the amount of core, though this matter may not often be the case, as much time would have to elapse before the cement would have hardened sufficiently to come up as stone in the cores. The effect on the rate of drilling is sometimes very marked. In the case of the cutoff for the Lahontan Dam of the U. S. Reclamation Service, the time required to drill the tertiary and succeeding holes over one section of the work was but a trifle more than half the time required for putting down

the makers what parts are subject to the most wear or liable to breakage? They are the only ones who know the factors of safety that have been allowed for. Yet it is most difficult to get one to give a list of parts that should be kept in stock to meet emergencies, and enable the machinery to be kept in service. This seems to be a most deep-rooted trait of American manufacturers, and does not reflect anything to their credit. Frequently machinery is out of service for months through the breakage or rapid wearing out of some part. Now it certainly does not seem like presuming a great deal to expect that the manufacturers of the apparatus should be able to supply a list of parts that should be carried in stock to prevent shutdowns. It is to be supposed that the manufacturer who has been building a line of machines for some time would be in a position, through experience, to know what parts wear out and require renewal; also the approximate number of spares or replacement parts that should be required to cover any specified period. Yet when you endeavor to obtain this information they try to put you off and make you believe that renewals will not be required for a long time, that the machinery should not require spares, as it is designed for long service, and similar piffle, whereas quite the contrary is true.

This is only one of the difficulties that exporters and importers in foreign countries are up against when dealing with American firms.

J. P. STONE.

Franklin, N. J.

What Caused the Quebec Failure?

SIR: Doubtless you have been, or will be, deluged with a flood of comments, criticisms and suggestions as to the recent Quebec Bridge disaster. I hesitate to attempt any participation in the discussion, particularly as I am not a bridge engineer at all, and the matter is therefore one outside the province of my practice and experience. However, there are involved fundamental principles of mechanics which any engineer, even if not a bridge expert, may recognize and discuss in relation to the great problem of the cause of this deplorable disaster. Saying that the cause was the failure of a certain casting is not an explanation but a mere statement of an incident of the disaster, comparable to saying that a person died because his heart stopped beating. The engineering world wants to know what caused the rupture of the casting properly assumed to be adequate, just as one seeks for the disease or functional disorder that caused the heart failure.

To suggest that the very scheme itself for the raising of this span was radically and fundamentally wrong may seem like presumption, in view of the array of able talent engaged upon this bridge, but that such is strictly the fact may be clearly demonstrated to anyone familiar with mechanical principles. Whether this is due to too many engineers attempting to act jointly, resulting, as is likely to happen, in each man treating his assigned elements, but no one possessing a large perspective of the whole problem and a strong responsible grasp of its solution, or whether there was lacking a necessary proportion of mechanical engineering talent, I have no information upon which to venture a suggestion.

However, it does appear that a mechanical engineer experienced in the design and

erection of heavy machinery would not have proposed the scheme which was used for jacking this span. Exclusive attention to the problems of stresses and strains does not qualify, and may disqualify even a most brilliant civil engineer from the handling of nice problems of the design of machine elements and special castings.

Without attempting here any criticism of the lifting girders, the suspender bars, the jacks or the details of the pumps and the piping, all of which seem to have been worked out with much care, note that this span was swung up suspended independently at four points. With this four-point system of suspension it would require almost mathematical nicety in the jacking operations to preserve uniform tension in the four suspenders, something almost impossible even with jacks resting on solid foundations, and not to be expected or considered with jacks transmitting their loads to the cantilever arms and through long suspender bars. Lacking this condition, some three of the four points must bear the load practically all of the time. To realize this it is only necessary to try a simple experiment, namely: Try to hang a box or any rectangular block or object by four strings, one attached to each of the four corners. One of the four strings will always be slack.

Now, if the support at any of the four corners was ever so little slack—that is, if the jacks at that corner failed to follow the other sets of jacks with utmost accuracy—one of two things would happen: either the entire load would be carried on the other three sets of suspenders or the whole mass would rotate about a line drawn diagonally through the structure from one bearing to the diagonally opposite bearing, depending on whether the center of gravity happens to be slightly on the one side or the other side of this diagonal. Wind and vibration might cause this rotation when the structure so supported at three points was nearly in equilibrium. With the failure of one set of jacks and then another to quite keep up with the other three there would be alternately three point suspension and then rotation. The action might be scarcely observable in a great structure, but constantly occurring, nevertheless, and any moment likely to become very considerable. It seems likely that there was anything but uniform lifting at the four corners of the truss, for it is reported that at one time one end was about 2 ft. higher than the other.

Now, further, the two rollers under each corner of this truss, one placed longitudinally and the other transversely, were admirably arranged to permit the structure to swing from its suspension either longitudinally or transversely. But what about a wind blowing at an angle, causing a swing neither lengthwise nor crosswise, but at an angle? In case the mass should swing off at an angle to the axis of the bridge, and in case of the rotation referred to, the latter being almost certain to occur, these two rollers constituted just the wrong device. A rotation of the structure due to failure of one or another of the four supports to carry its exact fourth of the load would rotate neither the one nor the other of the two rollers of the pair, but would set up a destructive effect in the two sets of bearings, wrenching the rollers and wrecking the bearings. This destructive effect could be expected to be tremendous, however slight the rotation, with such an immense weight as that of this span.

Note here also that while these suspenders and roller bearings were probably designed on the idea that each corner would carry one-fourth of the load, when the rotation about the diagonal occurred two bearings carried the whole weight, each bearing double that for which it was intended. Considering the enormous weight of the truss in question, it is only remarkable that the bearings were not wrecked before they were. That they were not can only be accounted for by the fact that on the erecting piers and on the scows the weight could be more nearly equalized than was possible when swung on flexible connections and structures, so that the movement in rotation was not too great for the endurance of the bearings, notwithstanding the pronounced destructive action.

A casual examination of available photographs of the wrecked bearing indicates that the foregoing supplies the explanation of what happened and why. It is needless critically to investigate the structure of the casting of the southwest bearing. Something might be said of the shape of these pieces from the standpoint of designing a casting, but no metal could endure the punishment that must have been inflicted on those bearings with this design when that enormous mass swung in diagonal rotation at the same time that double the normal weight was being carried.

A ball-and-socket joint was required instead of a pair of rollers. A large ball in spherical seats could have been used with properly designed castings. It seems, too, that some scheme of cable hoist properly equalized, perhaps followed by jacks as an extra precaution, could have been devised and thus a more flexible suspension made possible.

W. K. PALMER,
Consulting Engineer.

Kansas City.

[While the foregoing explanation sounds plausible, the fact remains that only one of the four castings failed, although during the collapse at least two other castings were subjected to even greater twisting and overloading than that suggested by Mr. Palmer. This truss span was not like a rigid box, but flexible enough to adjust itself to any slight unevenness in the four-corner suspension.—EDITOR.]

Forms for Concrete Test Specimens

The forms used for 6x12-in. cylindrical concrete test specimens are generally made of cast iron, and on account of the machining involved have cost from \$10 to \$12 apiece. Two years ago the structural materials testing laboratory of Lewis Institute, Chicago, began using forms made of cold-drawn seamless steel tubing, 3/16-in. thick. A size slightly larger than 6 in. in diameter was selected, and the pipe slit lengthwise with a cutter. The pipes were then sawn apart to 12-in. lengths. For service they are used with a 1/4x1-in. steel band drawn up by a 3/8-in. bolt 3 in. long. A bolt of this length is used so that a 1 1/4-in. sleeve can be put beneath the nut. This sets the latter away from the cylindrical surface far enough so that an ordinary wrench can be used for drawing up the bolt. The size of pipe selected is such that when tightly drawn the inside diameter is exactly 6 in. The cost of these forms was \$1.20 each. With the great advance in the price of steel during the last year they would probably cost quite a little more now.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.

Boiler Loaded on Two Trailers for 130-Mile Trip in Rockies

By GEORGE S. YOUNG
Bend, Oregon

HELD in place only by its own weight, a 6½-ton boiler was recently transported from Bend, Ore., to Alkali Lake, a distance of 130 miles, on two 3-ton trailers. The 100-hp. boiler was loaded on a cradle so made and supported that it acted like the platform of a tank car, with the two trailers occupying the place of the front and rear trucks. No ropes or chains were used to secure the boiler. The frame of the trailers was not sprung in the least by the trip.

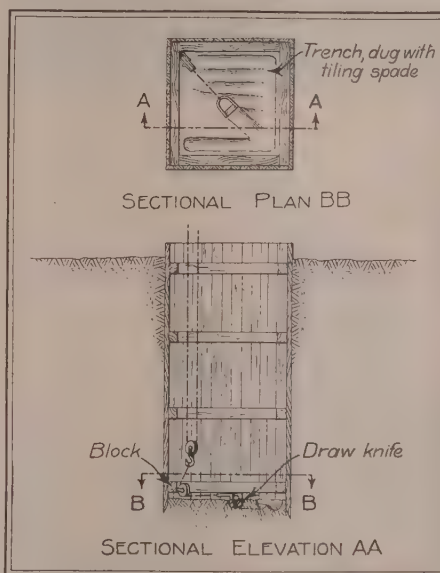
The two trailers were placed between two motor trucks, so that one truck acted as pusher. Both trucks were loaded with lumber, hardware, groceries, etc., to full capacity. George B. Milne of Bend, who had the contract to move the boiler and the 6½ tons of miscellaneous freight, etc., received his idea for this truck train from the "double headers" used on heavy railroad grades. A Cadillac preceded this truck train and acted as helper on heavy grades, being attached to the head truck with a long chain.

The trip is remarkable for its length, the great variety of roads hauled over and the heavy grades negotiated under this load. Grades as steep as 20 per cent were encountered and were easily overcome. No extra grading was done for this trip, and the roads, though used for a number of years, had never been graded except to pick out the rocks here and there. The trucks were new Four Wheel Drive trucks, never used before this run. The trip was made on 92 gal. of distillate and with less than 2 gal. of engine oil, in 25 hours' driving time.

Drawknife Pulled by Hoist Digs Tough Clay in Shaft Bottom

By D. H. FLEMING
Assistant City Engineer, St. Catharines, Ont.

THE ACCOMPANYING sketch shows how a hoisting engine was rigged up to pull a drawknife for cutting out strips of puttylike blue clay in sinking a 12-ft. square shaft for constructing a brick-lined sewer tunnel. A steam hoist and buckets were



DRAWKNIFE PULLED BY HOIST

the only plant on the job, and excavating the tough clay by the pick-and-shovel method proved a very slow process.

To get around the difficulty the contractor fastened a single block at the bottom of the shaft, in one corner. Through this was run a line to the upper end of which was hooked the hoisting fall, and the lower end of which was attached to an ordinary excavating draw-knife. In order to give the knife a start, an advance trench about 6 in. wide and a foot deep was cut on the two sides,

opposite the corner in which the block was located. Long slices extending across the shaft could then be cut out by the draw-knife. These were cut up into 18-in. lengths by one man with a spade, while another threw the pieces into the bucket and two others guided the drawknife. The device more than doubled the amount of excavation taken out in a day, while the daily cost remained the same.

Belts Used Successfully in Floating Concrete Roads

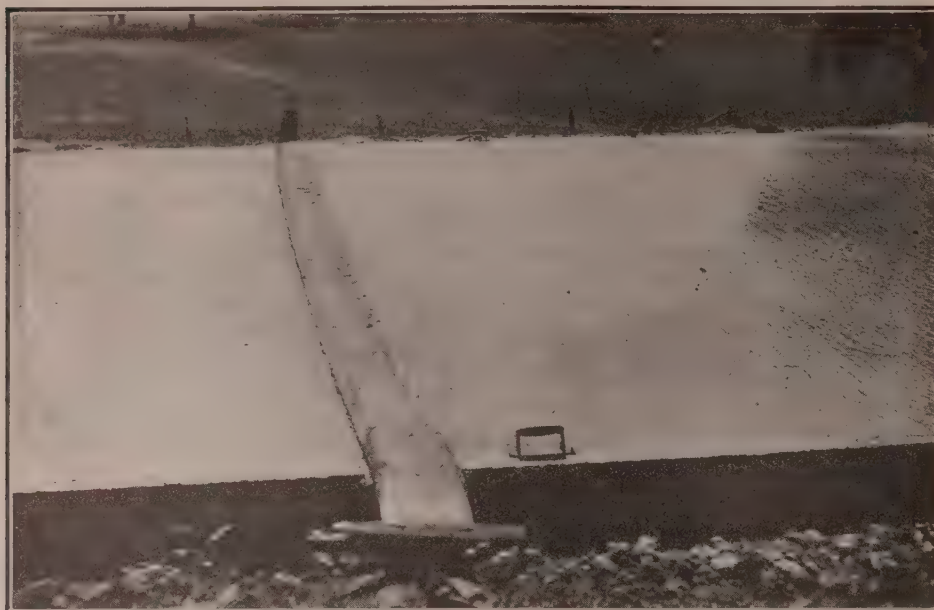
By H. B. BUSHNELL
Division Engineer, Illinois State Highway Department

HEAVY BELTS are being used to float concrete road surfaces on the Illinois state aid roads in Kane County between Elgin and St. Charles. Some time ago the possibility of using belting for the purpose was suggested to the writer, and as the theory seemed to have merit as a means of securing a better surface at a reduction in cost to the contractor he induced the Illinois Hydraulic Stone & Construction Company of Elgin, contractor for the work, to co-operate in giving the belt method a trial.

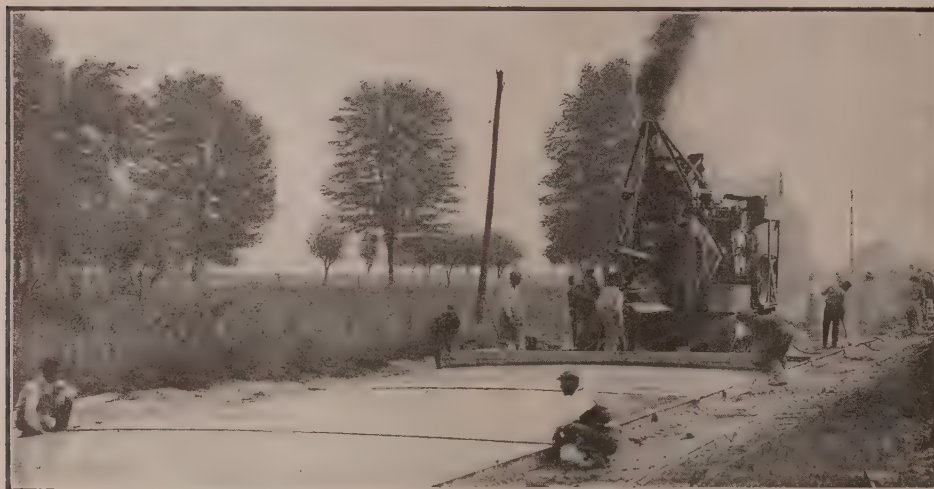
The road upon which this trial was made is 18 ft. wide, built under the standard specifications of the highway department and without joints. The belt used was an ordinary 3-ply canvas belt, 8 in. wide and 20 ft. long, with small wooden handles nailed and cleated to the ends. It was laid flat on the surface of the concrete and was worked back and forth over the side forms with practically the same motion as that used on the strike board. The concrete was mixed at the same consistency ordinarily specified, namely, so that when deposited in a pile it would tend to flatten but not to run at the edges. The deposited concrete was struck off in the usual manner with a common strike board. The surface was then gone over with the belt, very shortly after being struck off. If any porous, honey-combed or low places appeared after being



BOILER CONVERTED INTO A TWO-TRUCK CAR BY LOADING ON TWO 3-TON TRAILERS FOR 130-MILE TRIP OVER MOUNTAIN ROADS



FIRST FLOATING LEAVES CORRUGATIONS, AT RIGHT, WHICH SECOND FLOATING, AT LEFT, ELIMINATES



FINISHING WITH BELTS FOLLOWS MIXER CLOSELY ON MICHIGAN CONCRETE ROAD

struck off they were filled with soft concrete before the belt was used. The belt leveled off this material and filled all porous spots in an almost perfect manner.

Just before the initial set took place in the concrete the surface of the pavement was again gone over with the belt. After the first belt floating, slight ridges or corrugations of mortar appeared on the surface, but the second floating took out all of the corrugations and left a gritty, granular mortar surface absolutely free from ridges, pockets, depressions or float marks. An 8-in. belt gave better results for the first floating, while a 10-in. belt appeared to work better for the second floating. The heavier belt for the first floating had a tendency to cut into the surface and flatten the crown, but there is no such tendency with an 8-in. belt. The finished surface of the pavement can be made as granular as desired by retarding the time of the second floating.

Hand floating by means of wood floats has certain objections that it appears impossible, or at least impracticable, to eliminate. It is the practice of the Illinois Highway Department to require floating to be done just prior to the initial set in the concrete, so as to insure a fairly gritty and dense mortar wearing surface and to eliminate water pockets. It is very difficult to

do this at all times with a reasonable expenditure for labor on the part of the contractor. The floater is obliged to stay behind early in the morning when the temperature is low, and in the middle of the day when the concrete sets up faster he is hard pressed to catch up. Again, when it starts to rain it is often difficult to get the floating done at all before it is necessary to cover the pavement with canvas. Even with a very careful hand floating by use of

wood floats it is hard to secure a surface free from slight depressions or pockets, and this is especially true late in the day, when the floater tries to keep close to the strike board. Using a belt, 100 ft. of pavement can be floated in a very few minutes; and as the contractor expressed it, the labor is so ridiculously easy that it is almost play. The strike-board men can also handle the belt, and the contractor is therefore saved the cost of finishers or floaters.

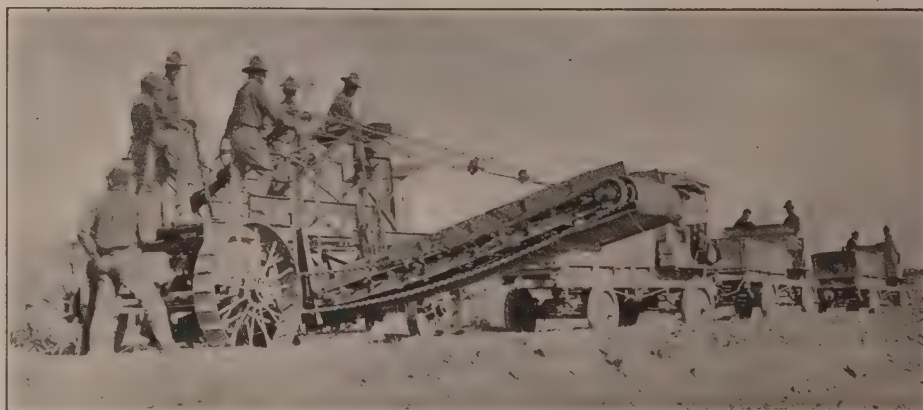
[One of the accompanying photographs shows the use of belts close to the mixer on the Seven-Mile Road near Redford in Wayne County, Mich., where this method has also been used. As in Kane County, the strike-board is used first, but following it a wide 12-in. belt is employed, the final floating being accomplished by an 8-in. belt. In Wayne County a Baker finishing machine is considered superior to the belt, but the belt method is believed to be better than hand floating. The officials state that the belt method seems to produce a very level surface, but how well the surface will wear as compared with other methods cannot be foretold.—EDITOR.]

Auto Truck Hauls Grader for Soldiers

IN MAKING army roads in Mexico all kinds of expedients are resorted to. Sometimes they become the regular thing after trial. A fleet of small scrapers and a number of the heavy side-conveyor type of grader have been kept busy ever since General Pershing's punitive expedition swept over the line. The photograph shows three Jeffery Quad trucks hauling a Russell grader. Only one truck is required for the smaller machines. The procedure is to set the scalping knife, slung on a 45-deg. angle, beneath the machine flush with the wheel line, so that it will slice off all bumps and eliminate all ruts. Often a bump will represent a sheer cut of 5½ in. through glutinous earth. The material is simply dumped to one side of the road.

Move 2600-Ton Building

A three-story class A steel-frame structure with brick facing is to be moved from lower Market Street in San Francisco to a point approximately 300 ft. distant on Mission Street. The structure, which weighs about 2600 tons, is being lifted by 200 jackscrews and will be hauled by three donkey engines in a manner similar to that employed in moving the Commercial High School, described Nov. 22, 1913.



MOTOR TRUCKS PULL MACHINE THAT SMOOTHS ROADS FOR ARMY TRANSPORTS

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Iron Span Falls When Post Is Struck by Runaway Car

West Third Street Bridge in Cleveland Drops 25 Feet to Baltimore & Ohio Railroad Tracks Below

When a runaway car jumped the track on the West Third Street bridge over the Baltimore & Ohio Railroad tracks in Cleveland, Ohio, on Oct. 3, and struck the hanger a glancing blow, then crashed into the first vertical post, the whole 105-ft. span sank gradually down to the railroad tracks, a distance of about 25 ft. Two persons were killed and many injured, as reported in the short note in the news pages of last week's issue.

The bridge was constructed in 1888, of wrought iron, the trusses being spaced 32 ft. 6 in. apart. It carried the double tracks of the Cleveland Railway Company, which cross the structure at the foot of the West Third Street hill. This hill, about 500 ft. long, has a grade of 9.6 per cent, and the tracks enter the span on a 30-deg. curve. A heavily loaded car, starting at the top of the hill, got beyond the control of the motorman, took the curve at the bottom of the hill at high speed, jumped the track and hit the south truss of the bridge, striking first the 3 x 5/8 in. hanger or end vertical, then completely displacing the next vertical post composed of two 7 in. channels

section. The bridge fell as an inevitable consequence. No evidence was found that indicated that the bridge had failed in a manner otherwise than that due to the unusual strain brought upon it when the heavy moving car smashed into the truss at the side of the bridge. The bridge was never supposed to be subjected to any such abnormal shock, and it was unable to withstand it."

Reports by Mr. Merton and Mr. Himes are of similar character. Both hold that the wrought-iron members of the bridge stood up remarkably despite 28 years of service. Whether the motorman of the runaway car became confused or the brakes were bad has not yet been decided by the Cleveland Railway Company. While the reports clearly absolve the city from any responsibility they do not attach any blame to the railway company.

A new span, costing \$25,000, has been ordered from the King Bridge Company, Cleveland. It will be erected by the Ferro Construction Company, Chicago.

Major-General George W. Goethals to Head 8-Hour Board

Major-General George W. Goethals has been selected by President Wilson to act as chairman of the board created by Congress to investigate the railroad eight-hour law. The

Plan Immediate Activity of Research Council

Engineering Foundation Resources at Disposal of National Research Council—Science and Engineering Well Represented

Arrangements have just been completed in New York whereby the resources of the Engineering Foundation, under the auspices of of the four principal national engineering societies, are placed at the disposal of the National Research Council, which was appointed by the National Academy of Science at the request of President Wilson. The object of the council is to co-ordinate the scientific research work of the country in order to secure efficiency in the solution of the problems of war and peace. The council was without funds until the Engineering Foundation, established to further scientific and engineering research, offered to place its resources at the council's disposal, including the services of its secretary, Dr. Cary T. Hutchinson, to act as secretary of the council. The offer was accepted and plans for immediate activities have been placed in the hands of an executive committee.

Personnel of Council

In indicating how thoroughly every branch of science and engineering is represented in the council, Dr. George E. Hale, director of



RUNAWAY CAR STRUCK VERTICAL POST AND WRECKED BRIDGE—CAR ON LEFT OF LEFT VIEW CAUSED THE ACCIDENT

laced together. In one of the accompanying photographs the damaged post and bent diagonal bars can be seen in the center of the view. In the other photograph, taken from the north side, two cars are seen in the wreckage. The one on the left is the runaway which caused the failure. The one on the right was just entering the bridge and was carried down with the span as it fell.

Investigation of the accident in order to fix responsibility has been begun for the city of Cleveland by A. J. Himes, chief engineer of the Nickel Plate Railroad; Robert Hoffmann, city engineering commissioner; Fred Richards, assistant engineering commissioner, and Henry Merton, of the Osborn Engineering Company of Cleveland. W. J. Watson, of Wilbur J. Watson & Company, consulting engineers, and W. C. Carter, former city engineer of Cleveland, are investigating for the railroad company.

Robert Hoffmann, city engineering commissioner, reported to Mayor Harry L. Davis: "The force of the collision of the car with the truss members was such that it tore an iron post, near the middle of the span, from its bottom connections, and so deflected the iron post and adjacent diagonal iron rods connected with the top chord of the truss that the chord was broken, thereby destroying the truss con-

other members are Edward E. Clark, of the Interstate Commerce Commission, and George Rublee, of the Federal Trade Commission.

While the law does not go into effect until next January, the President desires the members of the board to give close study to the entire situation. Besides observing the operation and effect of the institution of the eight-hour day, the commission will be authorized to conduct a general investigation of "the facts and conditions affecting the relations between such common carriers and employees."

After an inquiry of not more than nine nor less than six months from Jan. 1, the commission will report to the President and Congress. Pending the filing of this report, and for thirty days thereafter, the law provides that there shall be no reduction in wages of the employees affected for the standard eight hours of work.

Bidders Pay for Advertising Proposals

A resolution adopted by Trenton, N. J., provides that when bids are rejected because of the failure of the bidder to comply with all requirements and readvertising is necessary, the cost of such publicity shall be deducted from the amount of the certified check deposited with the proposal.

the Mount Wilson solar observatory and chairman of the council, who was in New York last week attending to the details of the arrangement, called attention to the personnel of the body. He said that it is the purpose of the council to enlist the co-operation, in the solution of our industrial and military problems of a scientific character, of every possible established agency. Medicine, for example, is represented by Dr. William H. Welch, president of the National Academy of Science; by Brig.-Gen. William C. Gorgas, surgeon general of the United States Army; Dr. Simon Flexner, director of the Rockefeller Medical Institute, and by Dr. Victor C. Vaughan, past-president of the American Medical Society. Biological science has as its representative Dr. Edwin G. Conklin, professor of zoology, Princeton University, while Dr. A. A. Noyes, of Massachusetts Institute of Technology, and Dr. L. H. Baekeland, form the chemical representation. Physics is represented by Dr. A. A. Michelson, of the University of Chicago, and electricity by Professor M. I. Pupin, of Columbia University.

Engineering Representatives

These branches, with the exception of medicine, are in the realm of pure science. Recognizing, however, that the practical applica-

tions of the principles which the pure scientists discover rest largely with engineers, there is a strong representation from the great engineering societies. Clemens Herschel, president of the American Society of Civil Engineers; John J. Carty, chief engineer of the American Telephone & Telegraph Company; Gano Dunn, president of the J. G. White Engineering Corporation; C. E. Skinner, director of the research laboratory of the Westinghouse Company, and Dr. W. R. Whitney, director of the research laboratory of the General Electric Company, are among those who will represent the engineering side of the council's work.

Military Representatives

The important military aspects will be presented to the council by Major General William Crozier, chief of ordnance of the U. S. A.; by Lieut. Col. George O. Squier, chief of aviation, U. S. A., and David W. Taylor, chief constructor, U. S. Navy. Other branches of the government are represented by Dr. S. W. Stratton, director of the National Bureau of Standards; Van H. Manning, director of the Bureau of Mines, and Prof. Charles F. Marvin, chief of the U. S. Weather Bureau.

It will thus be seen that the council includes representatives of all of the important scientific activities bearing on military or industrial problems. The executive committee's plans are of wide scope. The support already pledged will insure immediate action where the need is greatest.

The other members of the council are Dr. John A. Brashear, Pittsburgh; Dr. W. F. M. Goss, dean of engineering, University of Illinois; Dr. William H. Holmes, curator, U. S. National Museum; Dr. W. W. Keen, president, American Philosophical Society; Prof. E. C. Pickering, director, Harvard University observatory; Charles F. Rand, president, United Engineering Society; Prof. Theodore W. Richards, Harvard University; Prof. R. A. Millikan, University of Chicago; Ambrose Swasey, Cleveland; Dr. Elihu Thomson, Swampscott, Mass.; Dr. C. R. Van Hise, president, American Association for the Advancement of Science; Dr. Charles D. Walcott, secretary, Smithsonian Institution; Dr. J. M. Coulter, professor of botany, Princeton University; Prof. R. H. Chittenden, dean of Sheffield Scientific School, Yale University; Prof. Raymond Pearl, biologist, Maine Experiment Station, Orono, Me.; Marston T. Bogert, professor of organic chemistry, Columbia University.

Other members of the council will be appointed from time to time as the needs of the work dictate.

Think Government Nitrate Plants Legislation Unwise

The American Electrochemical Society, through its committee on public relations, constituted of the president and past-presidents of the society, has expressed the opinion that the recent legislation empowering the President to make an investigation to determine the best, cheapest and most available means for producing nitrates is unwise.

In a note addressed to the President, the Secretary of the Navy, and the Secretary of War, it is pointed out that the prime necessity of the hour is the prompt provision of an 18-months' supply on a war basis of Chilean nitrate, to be stored at various strategic points. The committee deprecates the entrance of the government into an industrial field that can, in their opinion, be much better and more rapidly developed by private interests.

300 Inspect Monolithic Brick Pavements at Paris, Ill.

About 300 engineers, contractors, highway and municipal officials, university professors, brick manufacturers and good-roads enthusiasts inspected the making of monolithic brick roads at Paris, Ill., Oct. 6, as the guests of the National Paving Brick Manufacturers' Association. This was the main feature of the second day's program of the thirteenth annual meeting held in Terre Haute, Ind., the first day being devoted to association affairs. All officers of the association were re-elected. C. C. Blair is president and Will P. Blair, secretary.

A section of brick road under construction on the outskirts of Paris near the waterworks system was used as a demonstration. The contractor, Allan Jay Parrish, had all operations from aggregate to covering the grouted surface with earth going on at the same time. The Parrish double template, putting on a 1/4-in. layer of 1:1 dry grout, was hauled forward by the Cube mixer with swinging beam. This template was preceded by a single one of channel iron drawn by hand to roughly level up the concrete. Both templates have rollers and ride on the Heltzel side forms. The operations of laying the brick and subsequently rolling and grouting with a small Marsh-Capron mixer, the first coat direct from the spout and the second from wheelbarrows, were carried out much as described by W. T. Blackburn in the Engineering Record, July 10, 1915, page 54.

Following a barbecue the guests were escorted over the monolithic roads around Paris. On most of the monolithic roads which were

built in 1915 and 1916 the grout finish has not yet entirely worn off. The time in service is too short to show any appreciable difference in the sections of 3-in. and 4-in. brick, both laid on a 4-in. base. A section of state-aid 13-ft. monolithic, 4-in. block on 4-in. base, laid this year with the new template, appeared to be slightly smoother than some of the earlier work, but both are excellent. Even in the narrow 9-ft. sections the edges have not been loosened, nor is there any sign of breaking down.

Dr. Cary T. Hutchinson Selected Secretary of Engineering Foundation

Dr. Cary T. Hutchinson has been selected secretary of the Engineering Foundation. Under the arrangement made with representatives of the National Academy of Science he will act also as secretary of the National Research Council.

Dr. Hutchinson was born in St. Louis and educated at Washington University, in his native city, and at Johns Hopkins University. He was with the Sprague Electric Company and the General Electric Company for several years and then became a member of the firm of Sprague, Duncan & Hutchinson, consulting electrical engineers. Since 1891 he has been in private practice. Among the important installations carried on under his direction were the electric equipment of the McCalls Ferry Power Company and the electrification of the Cascade tunnel.

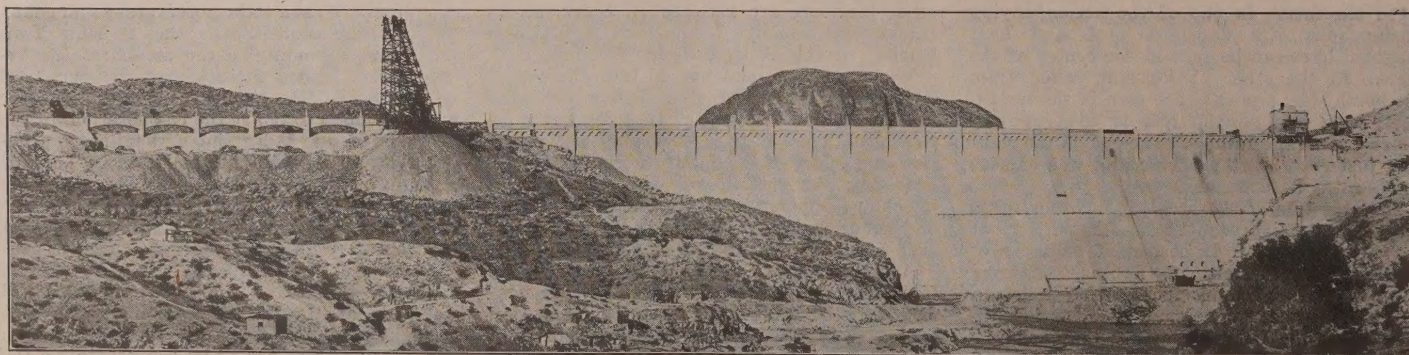
The Foundation has taken offices in the Engineering Societies' Building, 33 West Thirty-ninth Street, New York City.

Engineers Turned Away from Booster Dinner at Chicago

Although plates for 270 engineers were provided Oct. 6 for the annual booster dinner of the American Association of Engineers in Chicago, many men had to be turned away. For the speaking, however, 350 crowded into the hall.

Prof. C. Francis Harding of Purdue University addressed the association on "Marketing Engineering Ability." He analyzed the popular criticism of technical graduates and suggested that encouragement of the use of good English, both spoken and written, cultivation of tact and executive ability in young engineers, and the promotion of education in modern business methods would aid in lifting the engineer from the slough into which many feel he finds himself.

John Ericson, city engineer, discussed the



Will Dedicate \$5,000,000 Elephant Butte Dam To-day at El Paso, Texas

TODAY, the first day of the twenty-third International Irrigation Congress, will witness the formal dedication at El Paso, Tex., of the \$5,000,000 Elephant Butte dam. The huge structure, which was completed May 12 of this year, contains 611,400 cu. yd. of masonry, and has a total length of 1674 ft. and a maximum height of 306.2 ft. The maximum width at the base is 215 ft. At the top

is an 18-ft. roadway. The 275-ft. spillway, of the combination weir-tunnel type, is divided into five sections. The elevation of the crest is 193 ft. above the original river level. The excavation for the foundation totaled 407,300 cu. yd. The reservoir has a total capacity of 2,642,292 acre-feet, or 115,098,000,000 cu. ft., an average width of 1 1/4 miles and an average length of 45 miles. The available ca-

capacity is given as 2,683,860 acre-feet. The area of the water surface with the reservoir full is 40,680 acres. The cost of the dam proper was about \$4,500,000; the total project cost approximately \$5,000,000. Borings and surveys were made in 1904, construction was begun in 1910 and concrete was first poured June, 1913. About 23 miles of wagon road and 12 miles of railroad were built.

way in which the engineer can best render service in public life. Coming from one who has so long held office in Chicago, his remarks on the need of tact by the engineer were doubly impressive.

W. H. Rosecrans, consulting engineer, made a plea for more boosting and less knocking of the other fellow's work. J. N. Hatch, consulting engineer, outlined the progress of the organization and what it stood for. A year ago the membership was 100. Now it is 1200. L. K. Sherman, member of the Illinois Rivers and Lakes Commission, urged engineers to register and vote.

J. H. Prior, chief engineer, Illinois Public Utility Commission, pointed out the success of the organization. J. Holland, assistant engineer, North Works of the Illinois Steel Company, detailed an experience with draftsmen in the organization who were about to form a union. These men were taken in a body to the association and educated up to better things. The principles of the association, ideals of ethics and co-operation with their employers, so as to engender a better feeling all around, prevailed.

Other speakers were: Dabney Maury, consulting engineer; J. N. Lewis, mining engineer, Denver, and Arthur Kneisel, secretary of the association.

Who Wants a Permanent Job?

"Unless the members of the society are deceiving the secretary maliciously, they are all, or very near all, profitably employed. At least, it is like the old job of hunting for a needle in a haystack to find a man now when a position is open.

"To be sure, many are but 'temporary positions,' but when you get to the bottom of the whole thing there are no others. And who of us want a permanent job, anyhow?

"I well remember seeing a gray-haired draftsman packing his tools and books preparatory to leaving a 'temporary position' which he had accepted a short nineteen years before. When he found that it promised to merge into a permanent one he quit—and you would too, wouldn't you?"—*Bulletin, Oregon Society of Engineers.*

What Engineers and Contractors Are Doing

MAJOR-GENERAL GEORGE W. GOETHALS, Corps of Engineers, U. S. A., who recently resigned as Governor of the Panama Canal, has, as noted elsewhere in this issue, been appointed by President Wilson chairman of the board created by Congress to investigate railroad conditions in accordance with the Adamson law. After graduation from the U. S. Military Academy in 1880 General Goethals spent two years at the Engineer School of Application. For the next two years he was engineer officer at Vancouver Barracks, Department of Columbia, following which he directed improvements on the Ohio River. After a year at Cincinnati he went to West Point as instructor, later becoming assistant professor of civil and military engineering. From 1889 to 1894 he had charge of Tennessee River improvements from Chattanooga to Paducah, and for the succeeding 3½ years was assistant to chief of engineers of the army. Six months as chief engineer of the First Army Corps at Porto Rico was followed by his return to West Point as instructor in practical military engineering and to direct construction of the library building and filtration plant. General Goethals had charge of river and harbor improvements and fortification works in Rhode Island and southern Massachusetts from 1900 to 1903, and from then until 1907 he was a member of the general staff of the army. In March of that year he was made a member of the Isthmian Canal Commission, and a month

later was appointed its chairman and chief engineer. When the great ditch was practically completed early in 1914, General Goethals was appointed Governor of the Canal Zone. He was honorary president of the International Engineering Congress, held last year in San Francisco in 1915, and was present at the celebration of Goethals Day at the exposition.

H. G. SPARKS, formerly division engineer of the Chicago & Eastern Illinois Railroad at Salem, Ill., has been made assistant superintendent of the Chicago division. His headquarters will be at Brazil, Ind.

A. W. WHITE has been promoted from office engineer of the Chicago & Eastern Illinois Railroad to division engineer at Salem, Ill., succeeding H. G. Sparks, whose transfer is noted elsewhere in this issue.

J. S. MCBRIDE has been appointed principal assistant engineer at Chicago for the Chicago & Eastern Illinois Railroad. He will continue to perform the duties of his former position as valuation engineer in addition to those of his new appointment.

C. H. BLITMAN, formerly instructor in the college of engineering at the University of Minnesota, and later engineer in charge of municipal and paving work at Minot, N. D., is now city engineer and manager of Glasgow, Mont. Mr. Blitman is a graduate of Rensselaer Polytechnic Institute.

OSCAR S. MAPLE, who has for the last four years been associated with the Texas Power & Light Company at Dallas, Tex., as assistant construction engineer, is now with the Fargo Engineering Company of Jackson, Mich.

G. H. NICHOLS has left the employ of the Miami Conservancy District to become engineer on construction with the American Rolling Mill Company, of Middletown, Ohio. Mr. Nichols began his engineering career as chairman in the Department of Public Works of Ohio and was soon promoted to transitman and then to assistant engineer. After about three years with that department he resigned to join the forces of the Miami district.

EDWARD T. BAILEY, formerly with the Emerson Building Company, has become associated with Joseph O'Connor, formerly of the Fidelity & Casualty Company. They have opened offices at 103 Park Avenue, New York City, and will turn their attention to general contracting.

ROBERT F. OLDS, formerly consulting engineer, of El Paso, Tex., is now general superintendent of construction in the Philadelphia division of the Austin Company. After graduation from the University of Maine in 1906, Mr. Olds entered the employ of the Pennsylvania Steel Company and later joined the faculty of Pennsylvania State College as instructor in geometry and surveying. Late in 1907 he became associated with Charles W. Fenn, civil engineer, of Portland, Me. The year 1909 found him as civil engineer in the quartermaster's department, U. S. A., in which capacity he directed the construction of waterworks, warehouses and various buildings in the United States and the Philippine Islands. He resigned about a year ago to open consulting offices in El Paso.

JOHN EVANS, division engineer of the Michigan Central Railroad at Detroit, has been made division engineer of the Detroit Terminal and Toledo division. He will continue with office at Detroit.

J. D. ELDER has been appointed division engineer for the Michigan Central Railroad, with office at Niles, Mich.

C. C. HILL has been transferred from division engineer for the Michigan Central Railroad at Niles, Mich., to the valuation department.

CHARLES HARDING, erecting engineer for the New York Continental Jewell Filtration Company, has completed the plant at New Albany, Ind. He is now at Lawrenceville, Ill., to direct the installation of a 1,000,000 gal. plant.

LIEUT. COL. J. B. CAVANAUGH, Corps of Engineers, U. S. A., builder of the Lake Washington government canal, was recently entertained by the Seattle Chamber of Commerce at a banquet in the Butler Hotel. Tributes to his engineering ability were paid Colonel Cavanaugh by 300 of Seattle's representative business and professional men. Among the speakers were Judge Thomas Burke, president of the Chamber of Commerce; former U. S. Senator Samuel H. Piles; Will H. Parry, member of the Federal Trade Commission; Representative William E. Humphrey, and R. H. Thomson, former city engineer and present councilman.

C. E. GRUNSKY, of San Francisco, and George G. Anderson, of Los Angeles, were recently selected by the directors of the Imperial Irrigation District as an advisory board of consulting engineers to serve the district for a period of one year. Following the earlier appointment, which was noted in the Sept. 2 issue of this journal, the action of the irrigation district retains the engineers so that they will be available throughout the year for consultation on water supply, silt disposal, intake arrangement, flood protection and other problems that confront the district.

S. A. BROWN has resigned from the employ of the Pennsylvania Steel Company to enter the service of the Owosso Sugar Company at Lansing, Mich.

C. R. THOMAS, civil engineer, of Wilmington, N. C., has been appointed division engineer in the Kentucky Highway department to succeed O. S. Canning, resigned. After graduation from the University of North Carolina, Mr. Thomas took up special work at the University of Wisconsin. He later entered the employ of the government, where for six years he was engaged on highway work. Following his work with the government he was assistant engineer of the Pennsylvania state experiment station and then associated with a contractor of Wilmington, N. C.

EVERETT N. BRYAN has resigned as chief engineer and assistant superintendent for T. K. Beard, contractor, of Modesto, Cal., to become chief engineer of the Waterford (Cal.) Irrigation District. The district recently voted a bond issue of \$465,000 and as soon as plans and specifications have been prepared the contracts will be let for the construction of the system. Mr. Bryan was associated with T. K. Beard for 3½ years, during which period he directed work in the Oakdale, Turlock, Modesto and South San Joaquin irrigation districts. Previous to that he was superintendent of the Modesto Irrigation District.

C. H. DANCER, formerly deputy minister of public works for Manitoba, has been appointed district engineer at Winnipeg for the federal Department of Public Works.

EDGAR A. VAN DEUSEN, for the past four years chief draftsman in the New York office of the Southern Power Company, has been transferred to Charlotte, N. C.

Civil Service Examinations

Illinois—Examinations will be held Nov. 4 for testing engineer (salary, \$125 to \$200), architectural designer (salary, \$120 to \$200), topographical draftsman (salary, \$100 to \$150) and examiner of efficiency (salary, \$125 to \$175). Particulars may be obtained from the Illinois Civil Service Commission at Springfield.

United States—Examinations will be held Nov. 8 for copyist draftsman, junior drainage engineer, assistant inspector of hull material and laboratory assistant qualified in petrography. Applicants should ask for Form 1312.

Examinations Previously Announced

Date	See Eng. Record
Nov. 4. Junior engineering assistant,	
New York	Sept. 30

Low Center of Gravity Claimed for Contractor's Locomotive

A number of locomotives of the Decauville type which meet the requirements of contractors have recently been built by the Baldwin Locomotive Works for export trade. Aside from strong and simple construction, the low center of gravity obtained by placing the water tank between the sides of the steel-plate frames is claimed as another advantage.

The four-coupled locomotive was built for the Pleystowe Central Mills Company, Limited, Australia. It operates on a 2-ft. track

verted cylinder type, built in three different sizes and pressure capacities—1000, 750 and 300 tons. The illustration is a reproduction of the 1000-ton press.

It is claimed that the briquette-forming mechanism of these presses is unique in design and operation, capable of forming a briquette quickly and of uniform density. The material is placed in a floating mold, which is supported by four springs. When the pressure is applied from above, the friction of the material on the sides of the mold causes it to move down over a stationary plunger, which projects into the mold from below, thus apply-

clearance between the mold and the lower die in the 300-ton press. The briquette-forming mechanism of these presses has been patented in the United States, Canada and several foreign countries.

Business Notes

The Westport Paving Brick Company has removed its offices to Westport, Md. The company's mailing address is P. O. Box 23, Baltimore.

The John Kline Brick Company, Wickliffe, Ohio, is the newest and the thirty-fourth member of the Dunn Wire-Cut Lug Brick Company's family of licensees. This plant has a daily capacity of 40,000 brick.

The Modern Iron Works, Quincy, Ill., has opened a waterworks supply department. The officers of the firm are now busy organizing the new branch and will soon make a more complete announcement to waterworks men.

Wilbert O. Cornell, a graduate of the civil engineering department of the University of Pennsylvania, has been made a sales engineer for the General Fireproofing Company. His headquarters will be at Youngstown.

William H. Cummings, formerly of Providence, R. I., has become associated with the Waugh glazing department of the Asbestos Protected Metal Company.

Charles F. Ames has been appointed manager of the New York office of the Epping-Carpenter Pump Company.

C. W. Hays, formerly with Boyts, Porter & Company, of Connellsville, Pa., is now in charge of the pump department of the Ross Mechanical Supply Company, of Pittsburgh.

Albert & Davidson, Inc., Brooklyn, dealers in contractors' supplies and specializing in second-hand wrought-iron pipe, will move their offices to Oakland and Kent Streets.

The Walter A. Zelnicker Supply Company, of St. Louis, has just issued its September bulletin, said to be the largest published in several years.

The American Railway Bridge and Building Association will hold its twenty-sixth annual convention Oct. 17 to 20 in the Gruenwald Hotel, New Orleans.

Trade Publications

The following companies have recently issued trade literature:

The William Powell Company, Cincinnati. Folder, 3 x 6 in., 20 pages. Describes Powell valves.

Ingersoll-Rand Company, New York City. Bulletins 3033, 9024 and 4122, describing type XPV duplex steam-driven compressors, Beyer barometric-type steam-condensing plants and Leyner drill sharpeners respectively.

Independent Pneumatic Tool Company, Chicago. Circular devoted to Thor pneumatic tools.

Pneumatic Placing Company, New York City. Folder, 6 x 9 in., 4 pages. First of folders punched for binding and devoted to pneumatic concrete-conveying machinery.

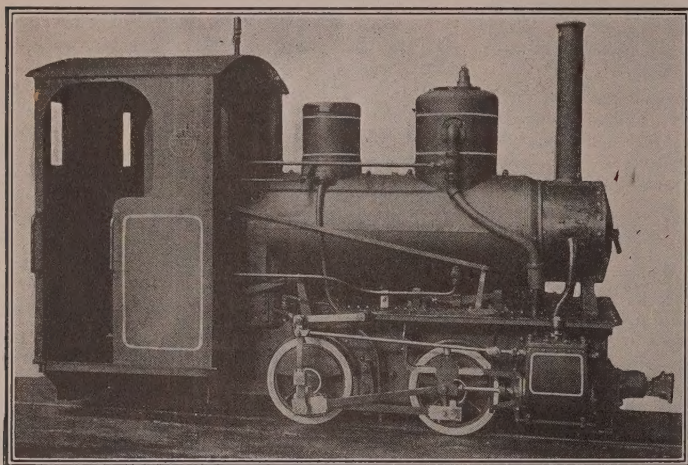
Holt Manufacturing Company, Peoria, Ill. Bulletin C-108. Describes and shows in operation Holt caterpillar tractor.

H. M. Byllesby & Company, engineers and managers, Chicago. Booklet, 8 x 11 in., 68 pages. Describes and shows buildings of public-utility properties in which the Standard Gas & Electric Company, a client of the Byllesby company, owns investments.

John F. Byers Machine Company, Ravenna, Ohio. Bulletin 1003. Advocates use of Byers "Auto-Crane" for handling material.

Sterling Motor Truck Company, Milwaukee, Wis. Folders describing 5-ton worm-drive and 7-ton chain-drive Sterling motor trucks.

Federal Motor Truck Company, Detroit. Portfolio of pictures showing different uses of Federal trucks by contractors and commercial houses.



FOUR-COUPLED LOCOMOTIVE BUILT FOR 2-FOOT TRACK WEIGHS 12,000 POUNDS AND OPERATES ON 3 PER CENT GRADE

on grades of 3 per cent and curves of 198-ft. radius. The boiler carries a steam pressure of 176 lb. per square inch and has a steel outside shell, a copper firebox and brass tubes. A box of 8 cu. ft. capacity is placed in the cab to hold bituminous coal. The tank capacity is 102 gal.

The steam dome is placed well forward on the boiler and the live-steam pipe passes out of the right side of the dome. The cylinders are 6 x 10 in. and fitted with plain slide valves. The equipment includes a handbrake with shoes on the rear driving wheels only. The locomotive weighs 12,000 lb. in working order.

Drop Box of Dynamite Caps 50 Feet with No Explosion Taking Place

Although it is dangerous to carry dynamite and caps in the same vehicle on account of the sensitiveness of the caps to shock, and the probability that their explosion would fire the dynamite, there are times when separate loading or two trips are inconvenient and expensive. To provide for such cases, and also to care for caps in the field, a safety box has been designed by E. I. du Pont de Nemours & Company.

The box, made of 3/4-in. oak with a top of 1/2-in. pine, is lined inside with 1/2-in. felt, obtainable at harness shops. The cap board is removable, but should fit snugly on and between the felts. The space between bottom of cover and top of bottom felt should be just right to hold caps firmly without undue pressure. The holes in the cap board—100 in number—should be large enough to permit easy entrance of caps, but not large enough to let them fall out.

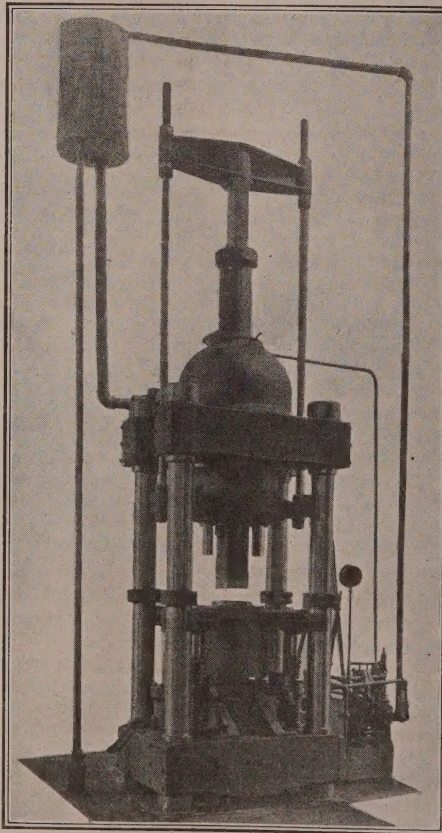
A box made this way is said to have been filled with 100 caps and thrown over a 50-ft. embankment into a quarry, where it bounced around on the rocks with no resultant explosion.

1000-Ton Hydraulic Press Used for Briquetting Metal Borings

A new design of hydraulic press recently built by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, is illustrated herewith. The press is used for briquetting metal borings, turnings, etc., so that they may be remelted without the loss of valuable ingredients and to prevent oxidation. It also puts the material in a convenient form for handling. The design is of the four-rod in-

ing pressure on the bottom as well as on the top to form a briquette of uniform density.

The briquette is ejected from the mold by the pressure of the main ram applied upon the briquette after the lower plunger has been removed by a simple movement of a controlling lever. The briquette then falls through to the base of the press, whence it is removed by a conveyor installed by the customer. On the 1000-ton and 750-ton presses hydraulic push cylinders lift the floating mold while the lower die is withdrawn or returned to place. A collar surrounding the lower die is held against the mold by a spring to close up all



FOUR-ROD, INVERTED-CYLINDER BRIQUETTING PRESS